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Editorial Note

The Interdisciplinary Research Review (IRR) was established with academic cooperation by the Nakhon Pathom Rajabhat University, The Royal Society of Thailand Committee of Interdisciplinary Research and Development, Rajabhat University (Western Group), and Rajamangala University of Technology Rattanakosin. This Issue, Volume 15 Number 1 (January – February 2020). This issue contains of ten interesting articles in multidisciplinary fields: (1) Performance evaluation of wavelet time-resolved phase-amplitude coupling estimates on small numbers of trials, (2) Quantitative study on the influence of principal's instructional leadership practices on the school culture: Teachers' perception, (3) Condom supply to global fund: An analysis of participation by Malaysian companies, (4) The development of organic agrotourism route connection in Ban Hua Ao Community, Sam Phan District, Nakhon Pathom Province, to promote tourism potential, (5) Risk factors causing sexual crimes, (6) Exploration of antibiotic usage pattern in dental professionals, (7) Factors that influence auditors' going concern audit opinion in Indonesia, (8) Linking corporate social responsibility, intellectual capital and corporate financial performance: Evidence from banking company in Indonesia, (9) Value added product development for oyster farmers' group in Kung Krabaen Bay Royal Development Study Center, Chanthaburi, and (10) The ability of various yeast strains to ferment alcohol from waste rambutan (*Nephelium lappaceum Linn*) fruit.

The Editorial Board of the IRR encourages anyone to submit articles for evaluation and review. The processes of submission, review and publication of articles are described on the journal's website, https://www.tci-thaijo.org/index.php/jtir. The Editorial Board and Committees of the IRR sincerely thank all peer reviewers who have sacrificed their time to help us produce a better journal, and also wish to thank all teachers, researchers and other academicians for submitting their valuable research to this journal. Finally, we thank readers of our journal who help to spread the knowledge and benefits gained to others. With your feedback and suggestions, we will strive to improve the quality and relevance of the IRR.

Yongyudh Vajaradul
Editor
Interdisciplinary Research Review

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Performance evaluation of wavelet time-resolved phase-amplitude coupling estimates on small numbers of trials

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Abstract

Time-resolved phase-amplitude coupling (tPAC) is increasingly used in clarifying the interactions between neuronal oscillation of different frequencies. In this study, Airy wavelet-based method for tPAC estimates on small numbers of trials is presented. The method was validated using both synthesized and experimental data. Simulation results suggested that tPAC analysis using more than 15 trials offers better joint time-frequency resolution. Experimental results showed that tPAC estimates on 30-, 50-, and 100-step cycles are able to detect similar significant coupling in the time-frequency plane. Dominant couplings are between ≈ 6 Hz and 8-32 Hz around heel contact. These frequency components partly overlap with the frequency components of motor unit activity during human treadmill walking. Wavelet tPAC analysis presented in this study may be used to track time-localised common oscillations in short segments of non-stationary neurophysiological signals with varying time and frequency resolution.

Keywords: Cross-frequency, non-stationary analysis, Morse wavelet, signal processing.
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1. Introduction

Signal processing has become increasingly important in the field of neuroscience [1 – 4]. Analysis of the frequency content of electrophysiological signals are useful ways to examine neuronal synchrony [1, 5]. A broad class of neurophysiological signals may be modeled as modulated oscillations, using analytic signals. Continuous complex-valued wavelet transforms play a key role in analysis of modulated oscillatory signals [6]. In recent years, analytic continuous wavelet transform − generalized Morse wavelets, have become a popular time-frequency analysis technique [7 –10]. They are highly flexible and form a two-parameter family of wavelets that have been used for studying time-varying properties of non-stationary neurophysiological signals [7, 11].

There are a number of popular measures used to investigate and characterise non-stationary neuronal coupling. Recently, there is increasing interest in clarifying the interactions between neuronal oscillations of different frequencies [11 – 16]. This form of interaction is commonly called cross-frequency coupling (CFC). One type of CFC, known as phase-amplitude coupling (PAC) or nested oscillation, occurs when the amplitude of a high frequency oscillation is modulated by the phase of a low frequency oscillation. More recently, several methods have been used to evaluate PAC on electrophysiology recordings such as electroencephalogram (EEG), local field potential (LFP) and other brain recordings [11, 14, 15, 17 – 22]. Most methods investigate PAC in the frequency domain and require long segments of experimental data. Recently, a time-resolved measure of phase-amplitude coupling (tPAC) between neural oscillation is used to detect temporal profile and frequencies of coupled oscillatory components [22]. The study of [22] suggests that tPAC provides high temporal resolution, the capacity of estimating coupling strength, and low sensitivity to noise conditions obtained with the short data lengths.

This paper focused on the application of wavelets and spectral tracking methods. The aim was to develop techniques that characterise short segments of data from natural movements. The behaviour of the generalised Morse wavelets-based method for tPAC analysis with an emphasis on small numbers of trials was explored. Our method was validated using both simulated and experimental data. We concluded with a discussion of our approach and recommendations regarding the current findings.

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2. Methods

2.1. The generalized Morse wavelets

The generalized Morse wavelets are complex-valued analytic wavelet transforms containing information on both amplitude and phase [6]. They are maybe a good choice for application to very time-localized structures [23, 24]. The generalised Morse wavelets form a two-parameter family of wavelets, β and γ. By varying these two parameters, the generalised Morse wavelets can take on a wide range of characteristics and still remain exactly analytic. The analyticity of wavelets ($\Psi(\omega) = 0$ for $\omega < 0$) is important for the analysis of strongly modulated signals, where the wavelets are required to be very narrow in time for matching the modulation time scale [23].

The zero order generalized Morse wavelet used in this study is defined in frequency domain as

$$\Psi_{\beta,\gamma}(\omega) = \sqrt{2}H(\omega)A_{k;\beta,\gamma}\omega^{\beta}e^{-\omega^{\gamma}} \tag{1}$$

where $H(\omega)$ is the Heaviside unit step function and $A_{k;\beta,\gamma}$ is a normalising constant that can be expressed by

$$A_{k;\beta,\gamma} = \sqrt{\pi\gamma 2^{r}\Gamma(k + 1/\Gamma(k + r))} \tag{2}$$

where $\Gamma(\bullet)$ denotes the gamma function and $r = (2\beta + 1)/\gamma$. The maximum amplitude occurs at the peak frequency [8],

$$\omega_{\beta,\gamma} \equiv \left(\frac{\beta}{\gamma}\right)^{\frac{1}{\gamma}} \tag{3}$$

The rescaled second derivative of the frequency-domain wavelets evaluated at its peak frequency is $P^2_{\beta,\gamma} \equiv \beta\gamma$, and $P_{\beta,\gamma}$ is called the dimensionless wavelet duration [6], defined as

$$P_{\beta,\gamma} \equiv \sqrt{\beta\gamma} \tag{4}$$

It is worth to note that Eq. (3) and (4) are key properties which depend only on two parameters, β and γ.

To explore the trade-off between time and frequency precision, the localisation measures (σ_t, σ_ω, $A_{\beta,\gamma}$, and $P^2_{\beta,\gamma}$) for some members of the generalized Morse wavelets are given in Table 1. Note that σ_t and σ_ω are a time width and a frequency width of the window function or a standard deviation (radius) in time and frequency of the wavelet, respectively. This table provides alternative choices for a particular application. For example, at fixed $P^2_{\beta,\gamma} = \beta\gamma = 12$, the Heisenberg area of $\gamma = 3$ is the most close to its lower bound for $\beta > 1$, as seen in Table 1. More details regarding the different roles of β and γ in controlling wavelet properties can be found in [6, 8, 23].

In summary, Airy wavelets ($\gamma = 3$) are desirable in this study because they give wavelets having a high degree of symmetry in the frequency domain, as seen in Table 1. Increasing β ($\beta > 3$) at γ= 3, the Heisenberg area of the generalized Morse wavelets ($A_{\beta,\gamma}$) approaches its theoretical lower bound at $A_{\beta,\gamma}$=0.5. This property may lead to good performance as previously mentioned. Increasing β at fixed γ, wavelets are more oscillatory and have a narrower bandwidth in the frequency domain. Generally, choosing a small value of β gives wavelets that are highly time-localized as opposed to frequency-localized, as seen in Table 1 for the values of σ_t and σ_ω. Note that with $\gamma = 3$, β should be grater than one ($\beta > \left(\frac{\gamma-1}{2}\right)$), as stated in [24].

2.2. Wavelet time-resolved phase-amplitude coupling estimates

Time-resolved PAC (tPAC) is a method to resolve PAC measures in time. Here, an estimation of tPAC in time-frequency map adapted from [22] and [25] can be calculated by

$$tPAC = \frac{1}{N}\sum_{n=1}^{N}\left(\frac{|Z_{f_A,f_P,n}|}{\sqrt{\overline{A^2_{f_A}}}}\right) \tag{5}$$

where N is the number of trials, $\overline{A^2_{f_A}}$ is mean value of $A^2_{f_A}$, and Z_{f_A,f_P} is given by

$$Z_{f_P,f_A} = |A_{f_A}| \cdot e^{i\phi_{f_P}} \tag{6}$$

Eq. (6) could be used to extract a phase-amplitude coupling measure where A_{f_A} is the envelope of higher-frequency oscillations, and ϕ_{f_P} is the phase of lower-frequency oscillations.

In this study, steps in the computation of tPAC based generalized Morse wavelets is shown in Fig. 1. First, the instantaneous amplitude envelope of the higher-frequency oscillation and instantaneous phase of the lower-frequency oscillation were calculated by obtaining an analytic representation of the original signal using generalized Morse wavelets. Secondly, the instantaneous amplitude and phase were extracted from the analytic representation, and then calculated as the absolute value and the phase angle of the analytic signal, respectively. The principle of the tPAC procedure requires the steps as the f_P with strongest phase-amplitude coupling with f_A bursts in each trial is searched for automatically using a power spectrum estimate [22]. To determine the dominant frequency f^*_P; the power spectrum P_A was estimated and its peaks were extracted. Also, the power spectrum P_x was estimated, and was used for finding the highest peak in P_A that co-occurred with a peak in P_x. See [22] for more details.

2.3. Confidence limits for tPAC estimates

To determine statistical significance of tPAC estimates, surrogate data are generated following the approach of [22] and [26]. Here, the amplitude information (A_{f_A}) in each trial is first split into five blocks. Then, these blocks are randomly permuted to yield a surrogate dataset. Further, the phase and amplitude information of the original data are shuffled randomly

Table 1. The localisation measures for some members of the generalized Morse wavelets.

	$\gamma = 2$				$\gamma = 3$				$\gamma = 4$			
β	σ_t	σ_ω	$A_{\beta,\gamma}$	$P^2_{\beta,\gamma}$	σ_t	σ_ω	$A_{\beta,\gamma}$	$P^2_{\beta,\gamma}$	σ_t	σ_ω	$A_{\beta,\gamma}$	$P^2_{\beta,\gamma}$
1	1.732	0.337	0.583	2	2.062	0.258	0.531	3	2.287	0.228	0.522	4
3	1.483	0.347	0.514	6	2.194	0.229	0.501	9	2.706	0.186	0.503	12
4	1.464	0.348	0.510	8	2.280	0.220	0.501	12	2.884	0.174	0.503	16
6	1.446	0.350	0.506	12	2.418	0.207	0.500	18	3.168	0.158	0.502	24
10	1.433	0.351	0.503	20	2.616	0.191	0.500	30	3.581	0.140	0.501	40
20	1.423	0.352	0.502	40	2.923	0.171	0.500	60	4.243	0.118	0.501	80
30	1.420	0.353	0.501	60	3.123	0.160	0.500	90	4.691	0.107	0.500	120

Note: the formulas for σ_t, σ_f are given in [23] and an example code is available at http://site.google.com.site/aguiarconraria/joanasoares-wavelets/the-astoolbox.

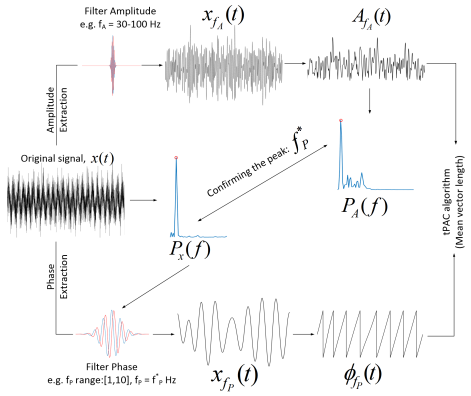

Figure 1: Graphical overview of tPAC method. Details are stated in text.

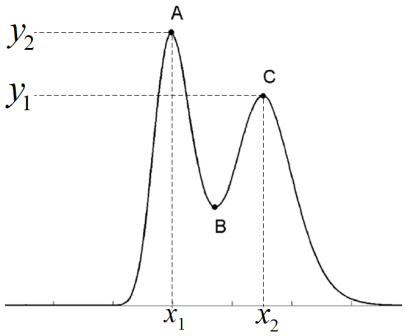

Figure 2: Plot showing criterion for spectral and temporal resolution adapted from [3].

between the different frequency components [27]. For each shuffled phase information obtained from the i^{th} frequency is randomly matched with the shuffled amplitude data from j^{th} frequency, where i and j are pseudorandom integers. The tPAC parameter estimates within the 95$^{\text{th}}$ percentile of the surrogate distribution are considered statistically significant.

2.4. Spectral and temporal resolution criteria

The test for spectral and temporal resolution is important in time-frequency analysis. Here, a measure of resolution based on the Rayleigh criterion and the study of [3] is used for performance evaluation of wavelet time-resolved phase-amplitude coupling estimates on each number of trials. Maximum resolution in the spectral and temporal domains is defined as minimum resolved frequency or interval for which conditions in Eq. (7) are true. Components x_1 and x_2 are resolved if normalized amplitude of coupling strength between the peaks B is less than half that of the lower of A and C which are defined in Fig. 2 [3].

$$Resolved(x_1, x_2) = \begin{cases} True : B < \frac{1}{2} min(A, C) \\ False : Otherwise \end{cases} \quad (7)$$

Additionally, we used Eq. (8), m, to recheck the performance of tPAC for testing the stability of temporal resolution. If m is high, tPAC measure is less stable in temporal resolution.

$$m = \frac{1}{Np - 1} \sum_{Np=1}^{Np-1} |y_2 - y_1| \quad (8)$$

where Np is number of peaks. y_2 and y_1 are defined in Fig. 2.

3. Application and results

3.1. General observations

In order to test the performance of the tPAC method using the generalized Morse wavelets, simulated data with controlled PAC parameters were used. It was generated using the method of [18] which was modeled as

$$x(t) = \overbrace{K_{f_P} \sin(2\pi f_P t)}^{x_{f_P}(t)} + \overbrace{A_{f_A}(t) \sin(2\pi f_A t)}^{x_{f_A}(t)} + \varepsilon(t) \quad (9)$$

where $\varepsilon(t)$ is additive noise, and

$$A_{f_A} = 0.5[K_{f_A}(1 - \chi) \sin(2\pi f_P t) + \bar{A}_{f_A}(t) + \chi + 1] \quad (10)$$

where $\bar{A}_{f_A}$ is a constant that determines the maximal amplitude of f_A, K_{f_P} and K_{f_A} are constant which determine the maximal amplitude of f_P and f_A, respectively. The parameter $\chi \in [0, 1]$ controls the intensity of the coupling: $\chi = 0$ represents maximum coupling while $\chi = 1$ is no coupling.

Here, the original signal was constructed with length of 2 s, sampling rate of 1000 Hz. Multiple modes of coupling in the study of [22] were applied for this testing, which were: during the first half of the signal (1 s), the phase of slow oscillation at f_{P_1} = 9 Hz was coupled to the amplitude of a faster oscillation at f_{A_1} = 115 Hz. In the second half, the first coupling mode was terminated and two other modes appeared simultaneously with f_{P_2} = 13 Hz, f_{A_2} = 145 Hz, f_{P_3} = 5 Hz, and f_{A_3} = 87 Hz, respectively. The signal-to-noise ratio was set to 6 dB, and the preferred coupling phase in the three modes were $\angle 270$, $\angle 0$, $\angle 180$, respectively. The coupling parameter (χ) in each mode were 0.5, 0.2, and zero, respectively. The frequency ranges of interest for f_P and f_A in the tPAC analysis were defined linearly as ranges $[1, 15]$ Hz and $[40, 200]$ Hz, respectively. The wavelet parameters, β was set to 3, 9 and 27. γ is 3. Here, tPAC analysis was calculated using averages over 100 trials.

Fig. 3 illustrates the tPAC analysis outcome on the synthesized data. Time-frequency maps reveal three coupling modes which there are areas of significant coupling between f_A=115 Hz and f_P=9 Hz during the time of 0-1 s, and the significant coupling between f_A=145 Hz, f_P=13 Hz and f_A=87 Hz, f_P=5 Hz occurred during the time of 1-2 s, as seen in tPAC coupling strength maps for f_A and f_P vs. time (Fig. 3(B)). The dominant coupling in each modes varied according to slow rhythm, for example, during the first half of the signal (1 s duration), the signal was averaged time locked to the troughs of the 9-Hz f_P cycle. Changing the value of β changes the frequency resolution of the corresponding wavelets. It is noticed that setting β to low value, the frequency resolution is decreased. Here, the results show that tPAC method is less accurate in detecting the coupling for β = 3. tPAC returns accurate results for setting value of β to 27, see Fig. 3(B)(top) compared to Fig. 3(B)(bottom). Note that time-frequency plots indicates values below the 95% confidence limit. Statistical significance test for tPAC is described in 2.3.

From the results given in this section, it has proved that tPAC method is more accurate in detecting the coupling for setting β to higher value. β = 27 and γ =3 may lead to good performance for time-frequency based tPAC analysis of simulated and experimental data in next section. The datasets used in the next section consist of different number of trials, which are 5, 15, 30, 50, and 100.

3.2. *Results from simulated data*

Fig. 4(A) shows examples of the time-frequency tPAC analysis outcome on the simulated data calculated using averages over 5, 30, and 100 trials. The time-frequency maps illustrate the time course of all three coupling modes. The improved performances in coupling detection can be observed when using larger number of trials as clearly seen in Fig. 4(A)(middle and right). Interestingly, time-frequency maps of tPAC estimates from 30 trials and 100 trials seem to have a similar time-frequency resolution. To evaluate the performances of tPAC analysis in term of time-frequency resolution, Fig. 4(B-C) and Table 2 and 3 are presented. Fig. 4(B) and (C) shows examples of time- and frequency-varying normalized amplitude of coupling strength formed by cross-sectioning the time-frequency plane at three coupling modes. The plots for tPAC analysis using 5 trials display more variability in normalized amplitude of coupling strength when compared to the others. Also, only tPAC analysis using 5 trials is not deemed to be resolved according to above criteria. The plots of Fig. 4(B) and (C) show that tPAC analysis using number of trials between 30 and 100 trials give generally good time-frequency resolution.

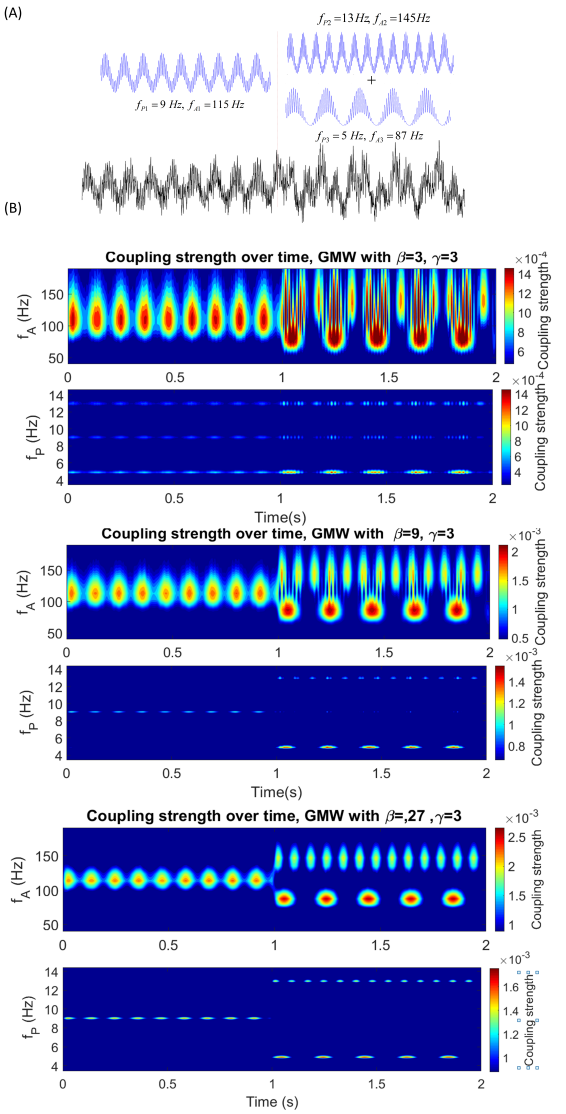

Figure 3: An example of tPAC analysis outcome on a synthesized data. (A) A synthesized data including three different coupling modes, see text for more details. (B) tPAC coupling strength maps for f_A and f_P vs. time. The 95% confidence limit for tPAC time-frequency plane is 0.47×10^{-3}.

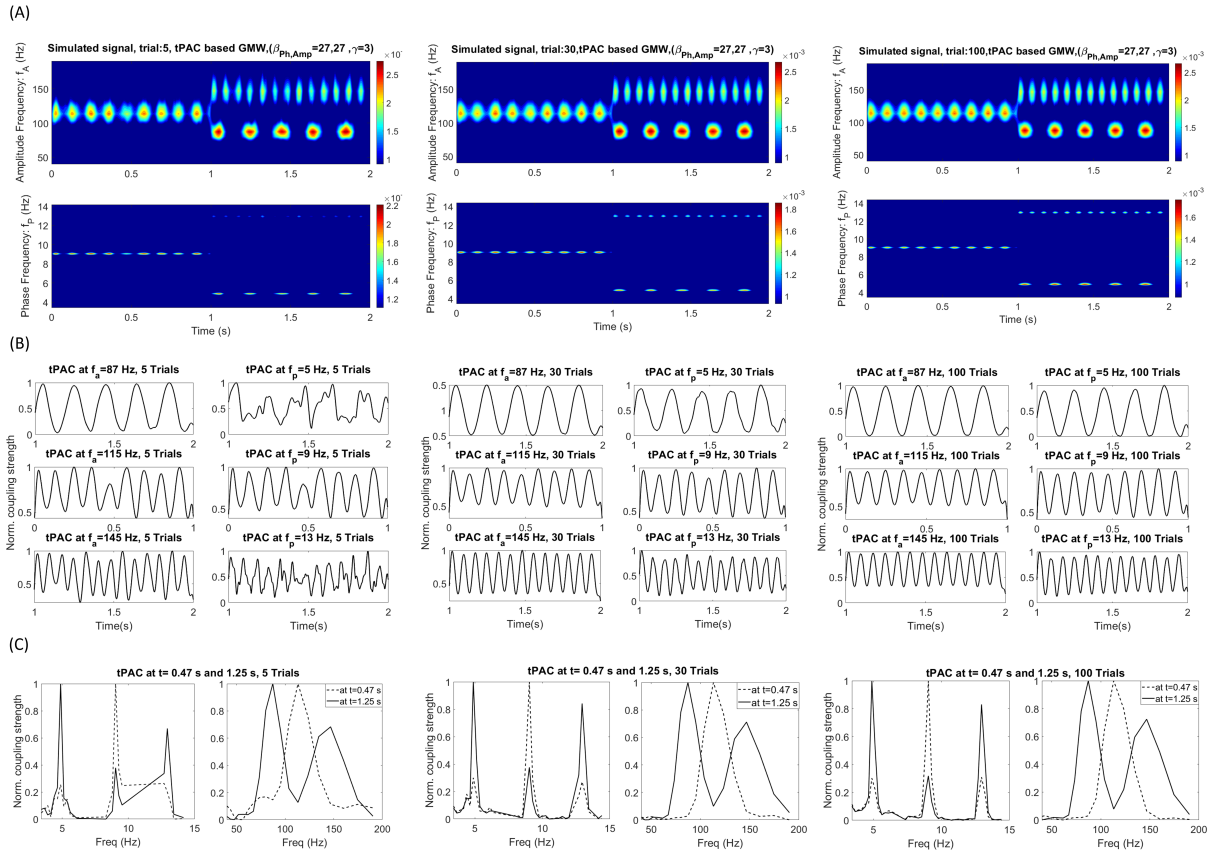

Figure 4: Examples of tPAC analysis outcome on a synthesized data calculated using averages over 5, 30, and 100 trials. (A) Plots showing time-varying normalized amplitude of coupling strength formed by cross-sectioning the time-frequency plane at three coupling modes, (f_P=5 Hz,f_A=87 Hz), (f_P=9 Hz,f_A=115 Hz), and (f_P=13 Hz,f_A=145 Hz). (B) Plots showing frequency-varying normalized amplitude of coupling strength formed by cross-sectioning the time-frequency plane at t=0.47 s and 1.25 s.

Table 2 lists the time resolution and the stability of time resolution, m of each number of trials when applied to the same simulated dataset used in Section 3.1. The table shows the maximum time resolution which is defined as the minimum resolved interval between adjacent bursts of signal using the method defined by Eq. (7) and Fig. 2. It can be seen that the time resolution and m of tPAC analysis using 5 trials performed slightly worse than using the other number of trials, especially at frequencies of 5 and 13 Hz, whereas in the other frequencies the time resolution and m do not decrease by more than 1 ms and 0.05, respectively. Table 3 lists the frequency resolution of tPAC analysis at each number of trials. It is interesting to note that the frequency resolution does not change by more than 5 Hz for any number of trials.

All results in this section would suggest that tPAC analysis using larger number of trials (> 15 trials) offers better joint time-frequency resolution.

3.3. Application to neurophysiology

The simulation procedure described above is repeated with experimental data. The data set analysed in this section comes from the study of [28]. This data set has been analysed and the novelty here is in application of time varying measures. The two EMG signals over the ankle flexor can be used as a substitute for pairs of motor unit recordings which can identify any modulation in the functional coupling during walking, and provide a basis for investigating the highly adaptive nature of human gait patterns [28]. EMG recordings were digitally sampled at rate of 1000 and 5000 Hz. Recordings were made over a period of 500 seconds. A contact switch identified heel strike. Thresholding of the heel strike (HS) record provides a sequence of trigger times. These trigger times provide a reference point within each step cycle which is used to segment the data for undertaking time-frequency analysis, where time is defined with respect to heel contact. Further details of experiments are given in [28]. The standard practice of rectification of surface EMG signals has been a commonly used pre-processing procedure that allows detection of EMG coherence [2] and was used here. EMG-EMG tPAC analysis was calculated using averages over 30-, 50-, and 100-step cycles. All steps were segmented into 1.04 s segments with 0.82 s before heel trigger and 0.22 s after heel trigger, as seen in Fig. 5(A). The time scale on time-frequency plots was labelled as 0-1.04 s, heel triggers are at 0.82 s in these plots. Thus, all plots cover swing phase including early, mid, and late swing for each step cycle. The EMG-EMG tPAC

Table 2. Temporal resolution and the stability of temporal resolution (in miliseconds; m) of each number of trials at each frequency.

Coupling freqs (Hz)	Number of trials				
	5	**15**	**30**	**50**	**100**
5	147;0.18	113;0.07	98;0.05	10;0.04	10;0.03
9	6.7;0.09	6.5;0.07	6.5;0.07	6.2;0.05	6.2;0.02
13	11;0.12	5.3;0.08	4.7;0.07	4.7;0.06	4.7;0.03
87	12.5;0.02	11;0.01	11;0.01	11;0.01	11;0.01
115	7.7;0.08	6.7;0.05	6.7;0.05	6.70.02	6.7;0.01
145	4.8;0.06	4.4;0.05	4.4;0.03	4.4;0.03	4.4;0.01

Table 3. Spectral resolution (in Hz) of each number of trials.

Coupling freqs (Hz)	Number of trials				
	5	**15**	**30**	**50**	**100**
5	2	2	2	2	2
9	5	2	2	2	2
13	5	3	2	2	2
87	40	40	35	35	35
115	70	55	50	50	50
145	60	60	60	60	60

analysis considered significant if above the 95% confidence limits, calculated in section 2.3 for tPAC.

In this study, the rhythmic modulation of motor unit activity, which reflects contributions from rhythmic cortical activity, obtained from paired surface EMG recordings over the ankle flexor TA is acquired with the goal of studying and investigating neuronal coupling mechanisms associated with locomotion. Features from theta (4-8 Hz), alpha (8-12 Hz), low-beta (12-20 Hz), high-beta (20-30 Hz), and gamma (30-45 Hz) frequency bands were extracted and analysed to identify any modulations in the functional coupling of motor units during walking. tPAC analysis was therefore applied to the data with f_P and f_A frequency ranges of interest, $[4-8]$ Hz and $[8-50]$ Hz, respectively.

Examples of paired rectified EMG signals during treadmill walking at 4 km/h and time-frequency tPAC analysis from 3 subjects analysed from 30-, 50-, and 100-step cycles are shown in Fig. 5. Some features shown on individual estimates are common across all subjects as illustrated in Fig. 5(B)-(D). Time-frequency maps show that coupling strength encompasses not only frequency components of motor unit correlation between 8 Hz and 20 Hz [28, 29], but also higher frequencies (>30 Hz) at ~0.8 s (around heel trigger). To summarise the correlation structure in group of subjects, the individual estimates are combined, or pooled, into a single representative estimate. Table 4 summarises the pooled estimates in different frequency bands. Although the results of tPAC present significant coupling in all frequency bands, it is worth noting that the coupling strength is concentrated in distinct frequency bands, showing peak values at $f_P \sim$ 6 Hz coupled to $f_A \sim$ 8-32 Hz. These strong coupling strengths are observed during late swing around heel contact (~ 0.74-0.82 s). Here, tPAC analysis using 30-, 50-, and 100-step cycles are able to detect similar significant coupling in the time-frequency plane.

4. Conclusion

tPAC analysis is used to detect timing and frequencies of coupled oscillatory components: a slower oscillation (f_P) and a faster oscillation (f_A), where the amplitude of faster oscillations is coupled to the phase of slower oscillation. This study has reviewed relevant theoretical aspects of tPAC analysis using generalized Morse wavelets. A particular subset of the generalized Morse wavelets, Airy wavelets (γ=3), are used in this study because they have zero asymmetry in time domain and are nearly symmetric in the frequency domain [6, 8]. Optimal value of β depends upon the requirement of the analysis. tPAC method is more accurate in detecting the coupling for setting β to higher value, as seen in Section 3.1.

In Section 3.2, results from tPAC analysis of simulated dataset, with an emphasis on small numbers of trials (5, 15, 30, 50, and 100 trials), are obtained using Airy wavelet with $\beta = 27$. The results show that performances in coupling detection improved with increasing numbers of trials. Overall, the results from tPAC analysis using number of trials more than 15 trials offers better joint time-frequency resolution.

The method has been used to characterise the correlation structure in experimental data consisting of paired surface EMG signals during treadmill walking, as seen in Section 3.3. The main finding is that tPAC method is able to detect localised correlation in the time-frequency plane. Our results suggest that tPAC analysis gives useful information for investigation of non-stationary neuronal coupling mechanisms underlying human treadmill locomotion, which involve only short segments (or small numbers of steps) of EMG recordings. The results indicate that theta oscillation ($f_P \sim$ 6 Hz) is strongly coupled to alpha and low-beta rhythms ($f_A \sim$ 8-20 Hz) during late swing. In addition, significant coupling is between ~ 6 Hz and ~ 20-45 Hz, specifically around heel contact. These frequency components partly overlap with the frequency

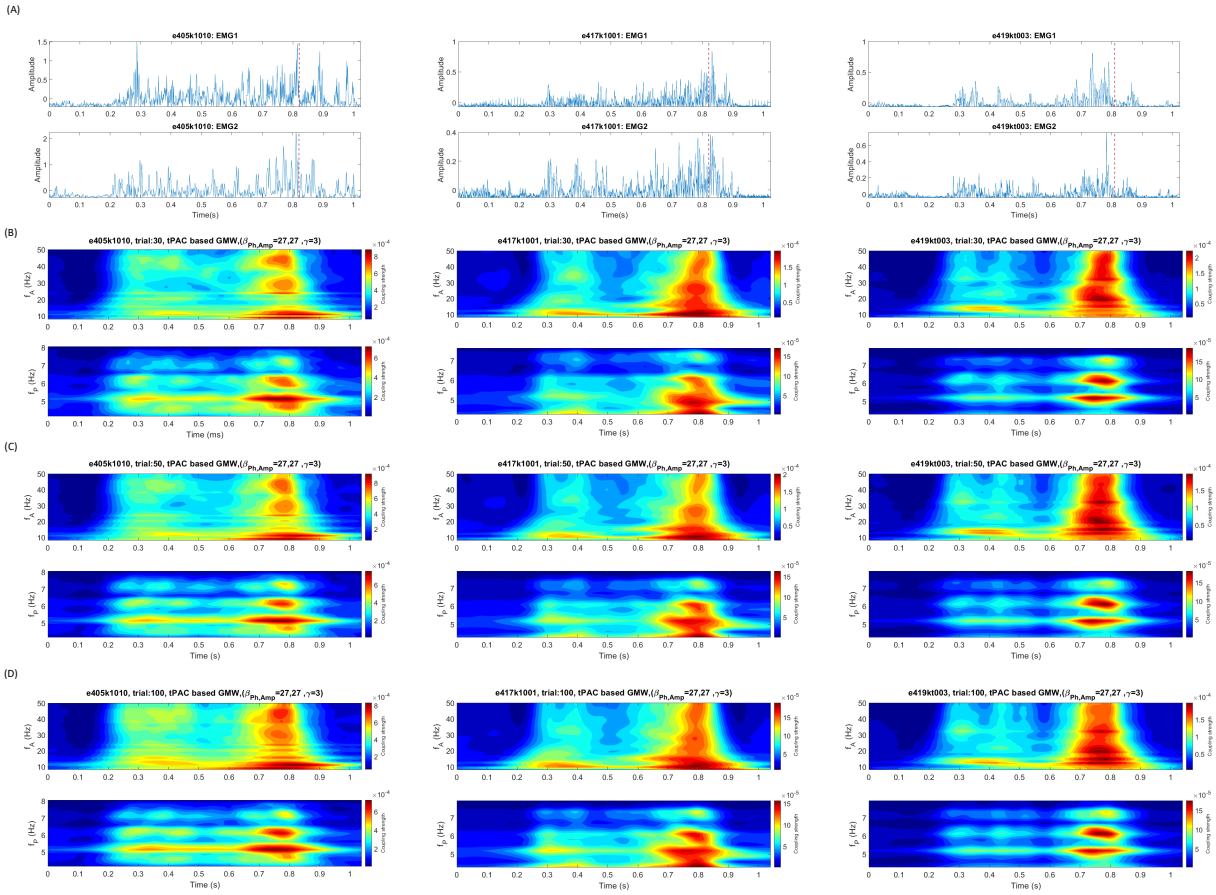

Figure 5: Examples of individual subjects analysed from 30-, 50-, and 100-step cycles, segmented into 1040 ms nonoverlapping epochs during treadmill walking. The time scale on time-frequency plots is labelled as 0-1.04 s, heel triggers are at 0.82 s. Columns represent records while rows represent (A) Examples of paired rectified surface EMG signals during treadmill walking, with dash red lines showing moments of heel strike. (B)-(D) Individual time-frequency tPAC maps analysed from 30-, 50, and 100-step cycles, respectively.

Table 4. Pooled peak time-frequency for tPAC analyses of all subjects during treadmill walking.

Frequency bands	Pooled tPAC estimates		
	30 trials	50 trials	100 trials
4-8 Hz	6 Hz, 0.75-0.79 s	6 Hz, 0.75-0.79 s	6 Hz, 0.75-0.79 s
8-12 Hz	8 Hz, 0.75-0.82 s	9 Hz, 0.78-0.79 s	9 Hz, 0.77-0.81 s
12-20 Hz	19 Hz, 0.74-0.79 s	19 Hz, 0.74-0.80 s	19 Hz, 0.74-0.80 s
20-30 Hz	24 Hz, 0.75-0.79 s	24 Hz, 0.76-0.79 s	24 Hz, 0.76-0.79 s
30-45 Hz	32 Hz, 0.77-0.80 s	32 Hz, 0.76-0.80 s	32 Hz, 0.76-0.80 s

ranges in the study of [30], who provide evidence in investigating the functional coupling between the motor cortex and TA muscles at 8-12 and 24-40 Hz in swing phase during treadmill walking. This finding is consistent with their suggestion that the motor cortex and the corticospinal tract contribute to the control of walking.

Although this study is constrained to EMG acquired during walking, this approach could be used to analyse EMG data from different walking speeds. Also, it is possible to apply tPAC analysis to other physiological data.

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Quantitative study on the influence of principal's instructional leadership practices on the school culture: Teachers' perception

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Abstract

This quantitative study aimed to: (1) explore Bhutanese middle secondary school teachers' level of perception on the principal's instructional leadership practices and the school culture, (2) explore the relationship between the principal's instructional leadership practices and the school culture, (3) construct the best predictive equation to predict the school culture using four dimensions of the principal's instructional practices in the school. The following statistics were employed for data analyses: means, standard deviations, the Pearson r analysis and stepwise regression analysis. It was found that there was a small positive correlation between demographic data of respondents and the school culture. The result indicated that the perception level of teachers on the principal's instructional practices and school culture were at high level (Mean = 3.68 and 3.82 respectively). There was a highly positive correlation between the principal's instructional practices and the school culture (Pearson r = .775 with $p \leq 0.01$, r^2 = .604). The best predictive dimension of school culture from the four dimensions of principal's instructional practices in the school was the improvement of instructional practices(X_2), management of people and resources(X_3) and allocation of resources(X_4) with r = .777, and significance level at 0.01.

Keywords: Principal's instructional leadership practices, four dimensions of instructional and leadership, school culture
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1. Introduction

The nature of school leadership is seen as one of designing strategies behind every successful school. However, understanding term leadership needs deeper exploration as the term leadership is operated and used differently by different authors. In short, there is no agreed prescriptive definition of leadership [1, 2], rather it has been justified under different situation by many writers. It is defined as an "influence on subordinates" [3, 4], "relationship between leader and employees" [2, 5] & "interpersonal influence" [6]. In short, it can be concluded that meaning of leadership in any organization is evolving with change in time and situations. Since, school is an organization where different individual works together to achieve common goals, the leadership behavior of school principals are seen as a very important aspect for the school success. The history of appointing Bhutanese as the school leader started only towards the end of 1980s until then, the schools in Bhutan were headed by head teachers from India [7]. However, school heads were directly appointed by the Ministry of Education without proper formal leadership qualification and training unlike the school leaders in Western school system. It was only in 2003 that the formal leadership training and higher study in school leadership and management was introduced in Bhutan [7]. Although, progressive development has taken place in our education system, improving quality of education has always remained as one of the foremost challenges. For instance, some of the issues are students' poor performance in academics, classroom size, access to education, and teacher retention. These challenges impose greater impact on the quality education delivery which further impacted the realization of educational goals [8]. To this end, principals' personal attributes and initiative are seen as most paramount factor that would enable schools to perform well despite steep challenges [9]. In addition, principals in Bhutan are considered as the most essential and significant person in making decision and overall management of the school [10]. Although large number of research on the instructional leadership and school culture has been conducted in Western context, the studies in these aspects were very limited in Bhutan. So, this study was carried out mainly to answer the following research

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questions;

1. What is the level of Bhutanese teachers' perception on the principal's instructional leadership practices and the school culture?

2. Is there any relationship between the principals' instructional leadership practices and the school culture?

3. What are the best predictive dimensions of the principal's instructional leadership practices in the school influencing school culture?

2. Literature Review on the Instructional Leadership and the School Culture

Studies on instructional leadership date backs to the early 1980s by Bridges and Bossert who claimed that "school administrator had little effect upon the field of education" before 1980s [11, 12, 13]. However, this claim was disputed by Austin [14] who stated principals' are the "expert instructional leaders who have high expectation from teachers and students to accomplish what they want". Towards the end of 1980s, many studies were conducted on instructional leadership and their roles as an instructional leaders in the school [15, 16, 17, 18, 19]. By the early 1990s, many authors came up with numerous definitions on the instructional leadership. This clearly highlights that there is no explicit description of instructional leadership as stated by Leithwood et al. [1] and even viewed as narrow and broad concept [20]. This brought numerous definitions of instructional leadership. For instance, Glickman, et al. [21] described instructional leadership as the "integration of the tasks of direct assistance to teachers, group development, staff development, curriculum development, and action research". Similar description was also made by Tice [44] who stated that instructional leadership means "enhancement of staff abilities". It means educators helping educators. An instructional leader understands and makes decisions which improve curriculum and instructions. Furthermore, [20] stated that instructional leaders are directly involved in classroom teaching and learning that affects students learning. In conclusion, instructional leader is considered as one very influential factor in building good school culture.

Research shows that the importance of culture was recognized as early as 1930; however, it was during the 1970s the educational researchers began to explore and draw direct link between the quality of school climate and its educational outcomes. Culture is a "strategic body of learned behaviors that gives both meaning and reality to its participants" [22]. It has been explained as the "collective programming of the mind which distinguishes the members of one group from another group" [23] and as a "complex pattern of norms, attitudes, beliefs, behaviors, values, ceremonies, traditions, and myths that are deeply ingrained in the very core of the organization" [24, 25, 26].

Volumes of research were carried out to investigate the relationship between instructional leadership and the school culture. For example, Gruenert [27] conducted a study to analyze the relationship between school culture and students' achievement in 81 Indiana elementary, middle, and high schools and he found significant relationships between various factors of school culture, school climate, leadership, and student achievement. Of most interest are the significant correlational relationships between school culture factors and student academic orientation, instructional management, and student achievement in both Maths and Language Arts. Similar findings were found by Leithwood [28] who stated that school leaders could shape the culture of school formally or informally and the change could be positive or negative [29]. This clearly indicates that the principal's leadership practices have either positive or negative impact on the school culture and also can lead to the better student academic performance.

3. Summary

Although many educational theorists have put numerous descriptions to the instructional leadership, it needs to be viewed from both broader and narrow perceptive. To this end, instructional leader must be viewed as a school leader who takes care of both teachers and students' climate positively. They should enhance positive learning culture through building conducive teaching and learning environment rather than focusing narrowly on one aspect.

4. Theoretical Framework

4.1. Instructional leadership

The study is grounded on the instructional leadership framework developed at the Centre for Educational Leadership, University of Washington by Rimmer [30]. This model proposes four dimensions for the instructional leadership practices of the principal:

4.1.1. Vision, mission and culture building

The first dimension outlines that principal as an instructional leader must embrace school vision of academic success through building well established culture of learning and creating conducive learning and working environment of both teachers and students [30]. In addition, Hoy & Miskel [26] put that instructional leaders give major priority in improving quality instruction in the school by incorporating in the school's visions and goals.

4.1.2. Improvement of instructional practices:

The second dimension focuses on enhancing and upgrading curriculum and instructions through establishing system of innovation, monitoring, evaluating, and reviewing for teacher development [30]. Similarly, Blasé & Blasé [31] added that principals as an instructional leaders should shoulder task to escalate developments in terms of classroom, staff and curriculum. In short, school leaders must take effort and energy on improving teaching and learning in the school through creativity and innovative professional development activities.

4.1.3. Allocation of Resources

Under this dimension principal as an instructional leader's role is to do strategic planning of budget and other resources allocation to upscale instructional practices [30]. Nevertheless, effective instructional leaders "integrate linkage" and deploy of all resources to achieve school purpose and mission [32].

4.1.4. Management of people and processes

This dimension emphasizes on the administering subordinates through professional development programs and creating conducive working environment to motivate and inspire them to establish culture of learning excellence [26, 30].

4.2. School culture

For school culture, the researcher used the theory developed by Steven Gruenert & Valintine [33] at the Middle Level Leadership Center. They have developed two different types of assessment tools for collecting data useful in faculty analysis and reflection about school culture. The first tool was the school culture Survey (SCS) measuring six factors: collaborative leadership which focuses on shared and distributed leadership, teacher collaboration which refers to teachers sharing and discussing ideas with each other, professional development which refers to individual teacher's professional and personal development, collegial support which refers to sense of belongingness to school, unity of purpose which refers to working collaboratively to achieve common goals, and learning partnership that is referred as improving and enhancing of students learning by partnering with different stakeholders.

4.3. Summary

Principals as instructional leaders play a very pivotal role in constructing positive culture that could enhance overall school improvement. A good school is based on good school culture which depends on school leadership. As discussed in literature review section school leaders are considered as the most paramount factor in creating proper teaching and learning culture. In fact, school leadership and school culture are mutually dependent. Nonetheless, school culture is one of the critical components to student and teachers effectiveness.

5. Research Methodology

The research methods are outlined below under the subheadings: Source of Data, Statistical Design, Instrumentation, Data Collection and Analysis.

5.1. Source of Data

The population of the study was 2786 teachers [34] of middle secondary schools in Bhutan. Simple Random Sampling Method was used for randomizing the sample size for this study and the total sample size of 370 teachers were selected using krejeice & Morgan [35] sample size table.

5.2. Statistical Design

Three statistical techniques were employed for data analyses to answer the three research questions: Descriptive Statistics to find teachers' level of perception on principal's instructional leadership practices and the school culture, the Pearson Product Moment Correlation Coefficient analysis was deployed to find the relationship between two variables(Instructional leadership and school culture) and stepwise multiple regression analysis was employed to find the best predictive factor of school culture using four dimensions of instructional leadership.

5.3. Research instrumentation

The specific steps followed in the construction of the research instrument were as follows: The instrument consisted of two parts; part I consisted of demographic data of respondents and 21 items questionnaire on four dimensions of principal's instructional practices in the school developed after literature review. For the school culture, 35 items questionnaire developed by Gruenert [33] was used. The questionnaire was checked for reliability test with 30 teachers who were not in sample. The Cronbach's α (alpha) reliability coefficient was calculated at .928 for instructional leadership and .835 for school culture. The reliability test indicated that the instrument was reliable for data collection.

5.4. Data Collection and Analysis

The researcher collected data from 370 middle secondary school teachers by distributing surveys. The following procedure of data analysis was operated through SPSS program. The Mean ($\bar{X}$) and Standard Deviation (SD) on the four dimensions of principals instructional practices in the school and the school culture were analyzed to study the perception level of the teachers. The Pearson Product Moment Correlation Coefficient was employed for studying and exploring the relationship between principal's instructional practices in the school and school culture. To construct

Table 1. Teacher's level of perception on principal instructional leadership practices and the school culture [N = 370].

Dimensions of principal's Instructional Leadership Practices in the school	Mean	S.D.	Perception Level
Vision, Mission and Culture Building [X_1]	3.99	.78	High
Improvement of Instructional Practices [X_2]	3.61	.81	High
Allocation of Resources [X_3]	3.53	1.13	High
Management of People and Resources [X_4]	3.77	.90	High
Principals Instructional Leadership Practices[X_T]	3.68	.78	High
School Culture Dimensions [Y]	3.82	.65	High

Table 2. Pearson product moment correlation coefficient between principals instructional leadership practices and school culture [N = 370].

Dimensions	X_1	X_2	X_3	X_4	X_T	Y
Vision, Mission and culture Building [X_1]	1	.757**	.565**	.826**	.854**	.644**
Improvement of Instructional Practices [X_2]		1	.660**	.724**	.926**	.723**
Allocation of resources [X_3]			1	.625**	.824**	.586**
Management of people and resources [X_4]				1	.858**	.715**
Principals instructional leadership practices [X_T]					1	.775**
School Culture [Y]						1

** Correlation is significant at the 0.01 level (2-tailed)

the best predictive equation to predict the school culture, stepwise method in multiple regressions was employed.

6. Result Analysis

Research Question-1: What is the level of Bhutanese teachers' perception on principals' instructional leadership practices and the school culture?

The table 1 reveals that in overall, the teacher's level of perception on principals instructional leadership practices in the school was at high level (Mean = 3.68). The teacher's level of perception on all the four dimensions of principals instructional practices were at a high level with Mean score at 3.99-(X_1), 3.61(X_2), 3.53 (X_3) and 3.77 (X_4). It was found that overall level of teacher's perception on school culture was high with Mean score at 3.82.

Research Question-2: Is there any relationship between Principals Instructional Practices and school culture?

Table 2 reveals that two dimensions of the principals instructional practices (Improvement of Instructional practices-X_2 and Management of people and resources-X_4) had a high positive correlation with school culture (The Pearson r = .723(X_2) and .715(X_4) with $p \leq 0.01$) while Vision, mission and culture building-(X_1) and Allocation of resources-(X_3) had moderate positive correlation with school culture (Pearson r = .644(X_1) and .586(X_3) with $p \leq 0.01$). The table showed that in overall there was a high positive correlation between the principals instructional practices (X_T) and the School Culture (Y)with Pearson r = .775 with p <0.01.

Research Question 3: What are the best predictive dimensions of the principal's instructional leadership practices in the school influencing school culture?

Table 3 shows the stepwise method of multiple regression analysis and the analysis produced F = 186.104 at 0.01 level of significance. That means the predictive variables (dimensions of principal's instructional practices) were significantly related to school culture. Thus, multiple Correlation Coefficients and regression Coefficients of the predictive variables were taken into account both in unstandardized and standardized scores to construct the best predictive equitation for the school culture. The results appear in table 4 and 5.

Table 4 shows the result of multiple regression using stepwise method to choose the best predictive variables for school culture from the four dimensions of principals instructional practices in the school, the first predictive variable selected was Improvement of Instructional Practices(X_2) and the analysis produced R = .723, R^2 = .522 and F = 402.087 with significance level at 0.01. When the second predictive variable which is management of people and resources (X_4) was selected and entered into equitation, it was found that the R = .774, R^2 = .599 changed F = 274.271 with at the 0.01 level of significance. Again when the third predictive variable Allocation of resources (X_3) entered into equitation, the R = .777, R^2 = .604 further increased and changed F = 186.104 with significance level at 0.01. The rest variable which is Vision, mission and culture building (X_1) dimensions of principal's instructional practices in the school was excluded from the analysis. Therefore, it can be concluded that the best predictive variables for the school

Table 3. Analysis of variance in stepwise method of multiple regression using school culture as criterion variable [N = 370].

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	94.096	3	31.365	186.104	.000[c]
Residual	61.684	366	.169		
Total	155.780	369			

Table 4. Multiple correlation coefficients and multiple coefficients of determinations between predictive variables and criterion variables [N = 370].

Predictors	R	R^2	F
X_2	.723[a]	.522	402.087**
X_2 X_4	.774[b]	.599	274.271**
X_2 X_4 X_3	.777[c]	.604	186.104**

** Significance Level 0.01(2-tailed)

culture (Y) were Improvements of Instructional practices (X_2), Management of people and resources (X_4) and allocation of resources (X_3), respectively. The Regression weights of the predictive variables were computed and tested for the significance to construct the best predictive equation; the results appear in table 6.

The Table 5 reveals that the regression coefficient of predictive variables in unstandardized scores was .312 for Improvement of Instructional practices (X_2), .268 for Management of people and resources (X_4) and .056 for Allocation of resources (X_3). The regression coefficients in standardized scores were .389 for improvement of instructional practices (X_2), .372 for management of people (X_4) and .097 for allocation of resources (X_3), which means that the three dimensions of principal's instructional practices in the school exert positive influence on the school culture. The multiple regression analysis produced multiple correlation (R) =.777 and multiple coefficient of determinations (R^2) = .604 with F = 186.104(significance at 0.01 level), that means 77.7% of the variation in school culture can be explained by improvement of instructional practices (X_2), management of people (X_4) and allocation of resources (X_3) dimensions of principals instructional practices in the school with standard error of estimation = .41053.

Thus, predictive regression for school culture can be written as follows; Unstandardized Score: Y' = 1.483 + .312(X_2) + .268(X_4) + .056(X_3) and Standardized Score: Z' = 1.483 + .389(X_2) + .372(X_4) + .097(X_3).

7. Discussions

The purpose of the study was to explore the influence of principal's instructional leadership practices on the school culture in Bhutanese middle secondary schools. Additionally, it aimed at answering three research questions: What is the level of Bhutanese teacher's perception on the principal's instructional leadership practices and school culture? Is there any relationship between the principal's instructional leadership practices and the school culture? What are the best predictive dimensions of principal's instructional leadership practices in the school influencing the school culture?

The findings of study revealed that the perception level of Bhutanese middle secondary school teachers on the principal's instructional leadership practices in the school and the school culture were statistically at high level; Furthermore, the effect sizes produced were large and impactful. The study was in line with finding of Tshering & Sawangmek [36] who conducted a study on instructional leadership and school effectiveness in the urban primary schools of Bhutan. Besides, principals in Bhutan are instructional leaders as they need to spend 65 percent of their role in facilitating curriculum and instructions [9].

There was also a highly positive correlation between the principal's instructional practices and the school culture as perceived by the middle secondary teachers. The finding supports the statement of Bolman and Deal [37] who stated that leaders who understand the significance of symbols and know how to evoke spirit and soul can shape more cohesive and effective organization. Nevertheless, the leaders' decision and action have direct impact on school culture which positively influences the student's achievement [38].

The best predictive dimension of the school culture from the four dimensions of principal's instructional practices in the school were improvement of instructional practices (X_2), management of people and resources (X_3) and allocation of resources (X_4), respectively. This finding supports the work of Dupont [39] who conducted a study on the teachers' perception of the influence of the instructional leadership on school culture. Moreover, the principal as an instructional leader plays major roles in forming and maintaining the school culture [40, 41]. In addition, principals can promote a positive culture, by acting in a certain way that sends signals to teachers and students that they can achieve more [42]. In addition, Hallinger [43] added that principals as instructional leaders must follow top down approach to improve curriculum and instruction in the school.

Table 5. Regression coefficient of significant predictors for school culture using stepwise method of multiple regression [N=370].

Predictors	b	β	SE	t
X_2	.312	.389	.041	7.534**
X_4	.268	.372	.036	7.484**
X_4	.056	.097	.026	2.125**
a = 1.483	R = .777	R^2 = .604	F = 186.104	SE = .41053

8. Conclusion

In conclusion, this research study has helped to provide empirical investigation on Bhutanese school principals' instructional practices and their influence on school culture in Bhutanese school setting. It has provided more understanding on whether Bhutanese school principals are really into instructional leadership practices as outlined in Bhutan's Ministry of Education policy guidelines documents. Also, the study has shed some light on the influence of principals' instructional leadership practices on school culture as perceived by teachers. The findings concluded that instructional practices of school principals' were found at statistically high level with high positive relationship between principals' instructional leadership practices and school culture. On the other hand, improvement of instructional practices(X_2), management of people and resources (X_3) and allocation of resources (X_4) of instructional leadership dimension, respectively were found as the best predictive factors of school culture in Bhutan.

9. Recommendations

The evidences reported in this research study support the following recommendations;

(1) The Bhutanese school principals' should focus more on the principal's instructional leadership dimensions of improvement of instructional practices, management of people and resources and allocation of resources to improve the school culture in their respective schools.

(2) The Ministry of Education in Bhutan should instruct school principals' to use the four dimensions of principal's instructional leadership practices in the school as guidelines to build positive school culture to enhance student learning achievement. Furthermore, the Ministry of Education should conduct leadership trainings and professional development programs for the school principals to enhance their instructional leadership skills.

10. Future Research

The following issues were deemed necessary for exploring the principal's instructional leadership practices in the school and the school culture:

(1) The research was carried only in the middle secondary schools of Bhutan through quantitative approach. Hence, similar research could be conducted including primary, lower and higher secondary schools of Bhutan through mixed method approach.

(2) The study was focused on the instructional leadership and its influence. Thus, study could be carried out examining other factors influencing the school culture such as school size, location, infrastructure and teacher competency.

(3) The sample in this study includes only the perception of teachers. So, to have more accurate findings data's could be collected from school principals as a instructional leader.

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Condom supply to global fund: An analysis of participation by Malaysian companies

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Abstract

Malaysia, the world's largest single exporter of condoms, supplies of condoms to Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) recipients is valued at about USD37 billion which is about 41% of the total USD91 million condoms procured for the period of 2008–2013. This is despite the backdrop of encouraging local production of health commodities in Africa and participation of local African manufacturers to be qualified suppliers. There has also been reported instances of poor quality products supplied, breach in procurement procedures, and high unit costs of condoms. This study identified the country characteristics and product characteristics of Malaysia's firms supply of condoms to the Global Fund programme. The study also contributes in providing decision-makers and suppliers (not only limited to Malaysian suppliers) on the important country and product characteristics in the supply of contraceptives besides increasing information to potential applicants for tender called by GFATM. Random effect estimation was conducted on unbalanced panel data of Malaysia's supply of condoms to Global Fund recipients in 44 countries for the period of 2008–2013. In terms of country characteristics, HIV prevalence and African countries were significantly positive, while being a fragile state (World Bank classification), health expenditure per capita and number of physician per 1,000 people were insignificant. For product characteristics, average quantity divided by distance between Malaysia and recipient country, and average unit price of below USD0.07 were significant but average unit price of below USD0.02 were insignificant (average price based on past literature of procurement for Global Fund). The increased analysis and discussion of these country and product characteristics based on data on public domain (for increased transparency) has noticeable effect towards more efficient supply process. Suppliers or aspiring suppliers may supply condoms for social cause to the recipients in countries that need them at product characteristics most required, thus also contributing to more efficient tender and supply process.

Keywords: Global Fund, condom, country characteristics, product characteristics
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1. Introduction

The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) is a partnership launched in 2002 to support programs and communities most in need. Over USD10 billion has been invested between 2014 and 2016 for the procurement and management of health products to support countries fighting AIDS, TB and malaria and improving health systems, and about half of the amount is in the procurement and management of health products [1]. One of the products required under the program is sheath contraceptives. Contraceptives are a critical component in a holistic and sustainable approach to the HIV prevention [2]. Malaysia is the world's largest exporter of sheath contraceptives [3]. Malaysia's export of contraceptives (HS401410) was value at USD 93.6 million in 2016 based on data from the United Nations International Trade Statistics Database (UN Comtrade).

GFATM secretariat will propose a grant agreement with a principal recipient after a proposal is approved [4]. A principal recipient is an organisation nominated by the Country Coordinating Mechanisms to receive funds, implement programs and disburse funds to sub-recipients. The approval is far from automatic, where grants are given based on merit of proposals [5], and approval is not more than half of the proposals submitted [4]. GFATM remains an important source of funding as HIV/AIDS programs in many high-prevalence, low-income countries rely heavily on external funding [6]. The price and quality reporting (PQR) was introduced by GFATM in 20057 which collects the procurement transactions data made by Global Fund-supported programs. Wafula [8] argued that PQR collects a substantial amount of data but there is no or

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limited published analysis on regional and temporal variations.

In the process of supply of condoms to recipients of the GFATM, there are also several instances of poor quality products supplied, breach in procurement procedures, and high unit costs of condoms supplied. In 2016, it was reported that Ethiopia needed to dispose USD 2 million worth of contraceptives purchased from an unnamed Indian company as they were defective and of poor quality [9]. Meanwhile, procurement procedures were breached in Ghana in 2013, where only about 1% of the total quantity required is supplied and the size were smaller than required [10]. Besides that, the Namimbian government, under the pressure from Global Fund, terminated supply arrangement with Comex in 2010 due to the high unit costs of condoms supplied by Comex [11].

As the leading global exporter of sheath contraceptives, Malaysian exporters' participation in the supply to Global Fund programs is important as it enables these companies to produce their products at an internationally-benchmarked reasonable pricing without compromising the quality for a social cause at the same time. Humanitarian aid is also an important business component for contraceptives corporations. Karex [12], the largest condom manufacturer globally highlighted that its sales in 2016/2017 financial year were affected by non-governmental organisations' uncertainty to secure humanitarian aid. The acceptance of decision-makers to select Malaysian firms also shows that Malaysian firms understand the need of the recipients in the target countries.

Based on an analysis [13] to make the case for investment in condom for 81 countries in 2015, the number of condom required for HIV and sexually transmitted infections prevention is estimated to be at 26.7 billion pieces but only 15.8 billion were used in the sample of 81 countries. The condom gap is estimated to be concentrated in Southern Asia, and Middle and Western Africa. Meanwhile, in the analysis of procurement cost trends for the Global Fund [8], it was reported that the procurement costs of condoms have remained constant and relatively stable between 2005 and 2012. Male condoms are the most procured type of condom. The Eastern Europe and Central Asia (EECA) regions had the highest median cost, at USD0.07 while the lowest median cost of condoms is in the Sub-Saharan Africa West and Central Africa (SSA-WCA), South Asia and Middle East and North Africa (MENA) regions, at USD0.02. This reported cost is within the range reported by Karex. Karex highlighted that the company, as an original equipment manufacturer (OEM), sells a piece of condom at an average price of USD0.03. Meanwhile, the data from UN Comtrade shows that, the average price for sheath contraceptives for the period of 1989–1996 and 1999 is around USD0.02–0.20. Studies also [8, 14] further suggested that future analyses to describe variation in unit costs of Global Fund commodities in greater depth.

Karex [12] as the only public listed contraceptives company in Malaysia maintains that tender market is still relatively important for manufacturers. The tender market contributes around 50%–54% of Karex's revenue between 2015 and 2017. Karex participates in tenders called by institutions such as United Nations Population Fund (UNFPA), United States Agency for International Development (USAID), Population Service International (PSI), Marie Stopes International (MSI), John Snow Inc (JSI) and Crown Agents International Limited. Another listed condom company in Thailand [16] also reported that the average contribution of tender business to the total revenue is between 25%–37% in the period of 2013–2015.

Although the Global Fund has stated that local production of health commodities in Africa and participation of local African manufacturers to be qualified suppliers is encouraged, the involvement of Malaysia's sheath contraceptives companies in the supply is still noticeable. The supply of male condoms by Malaysia, as a single country, to GFATM recipients is valued at about USD37 billion which is about 41% of the total USD91 million for the period of 2008-2013. Condoms procured under the Global Fund needs to fulfil the World Health Organisation (WHO) Procurement Guidelines [17]. The contraceptives by Malaysia to GFATM recipients were supplied to 44 countries which consists of 11 countries classified as low-income, 19 lower middle-income countries while the remaining 14 are high middle-income countries based on World Bank [18] classification (full list of recipient countries are listed in Table 6 in Appendix).

The objectives of this study were to identify the country characteristics and product characteristics in Malaysian companies supply of contraceptives to the GFATM programme. The study also contributes in providing decision-makers and suppliers (not only limited to Malaysian suppliers) on the important country and product characteristics in the supply of contraceptives besides increasing information to increase potential applicants' success of tender by the Global Fund. This information is significant to contraceptive companies as the tender segment still remains significant to many of these companies. This study also provides information to stakeholders for benchmarking on the product characteristics to make more well-informed decision during procurement process. A distinction of this study is the identification of suppliers from a specific country (Malaysia in this case) which was not available in past studies analysing procurement and supply to Global Fund recipients, at least by studies using publicly available data. A solid evidence based on pricing could empower the developing countries to make cost-effective procurement choices [14], which is a critical factor in the long-term sustainability of treatment for HIV/AIDS.

Table 1. Malaysia's exporters in sheath contraceptives supply to global fund.

Dongkuk Techno Rubber Ind	Nulatex Sdn. Bhd.
Innolatex Sdn Bhd	Pleasure Latex Products
Karex Industries Sdn Bhd	SSN Medical Products Sdn Bhd
Medical Latex (DUA) Sdn. Bhd.	

Table 2. Correlation matrix for study variables.

	$\ln(HEALTH)$	$\ln(HIV)$	$AFRICA$	$\ln(FS)$	$\ln(\frac{P}{1000})$
$\ln(HEALTH)$	1.000000	-0.207955	-0.016824	0.258836	0.182955
$\ln(HIV)$	-0.207955	1.000000	0.648100	-0.052001	-0.578005
$AFRICA$	-0.016824	0.648100	1.000000	0.300681	-0.466344
$\ln(FS)$	0.258836	-0.052001	0.300681	1.000000	-0.021695
$\ln(\frac{P}{1000})$	0.182955	-0.578005	-0.466344	-0.021695	1.000000

2. Methods

Recipients in 44 countries reported the purchase of contraceptives from Malaysia between 2008 and 2013. The first part of this study looked into the country characteristics to assess the extent to which physicians per 1,000 people, the prevalence of HIV, whether as a fragile state, and whether being an African state are significant determinants to Malaysian companies' involvement in supplying condoms to GFATM recipients. This study adapted and modified the model in past study [5], which employed random model estimations to examine the major determinants of Global Fund grant implementation in developing countries.

The following empirical model to examine the relationship of country characteristics with Malaysia's supply of contraceptives to Global Fund was employed using random-effect panel estimation:

$$\ln\left(C_{ij}\right) = \ln\left(\frac{P}{1000_j}\right) + \ln\left(HIV_j\right) + \ln\left(FS_j\right) + AFR_j \tag{1}$$

where C is the value of contraceptives supplied by Malaysian companies to Global Fund programme, $\frac{P}{1000}$ is the number of physicians for every 1,000 people, HIV is the prevalence of HIV, FS is whether a country is a fragile state (dummy of 1 for yes; 0 for no), AFR is whether a recipient country is an African country (dummy of 1 for yes; 0 for no), ln is the natural logarithm, i refers to the exporting country, j refers to the importing country.

The second part of this study analyses the product characteristics of condoms supplied to Global Fund recipients:

$$\ln\left(C_{ij}\right) = \ln\left(\frac{Q}{D}\right) + \frac{C}{Q}0.07 + \frac{C}{Q}0.02 \tag{2}$$

where $\frac{Q}{D}$ is the average distance of recipient country from Malaysia, $\frac{C}{Q}0.07$ is the whether the average price of the supply is below USD0.07 per unit (1 for yes; 0 for no). $\frac{C}{Q}0.02$ is the whether the average price of the supply is below USD0.02 per unit (1 for yes; 0 for no).

The average price of USD0.07 and 0.02 is based on past literature of procurement for Global Fund [8].

Random effect (RE) is because of greater flexibility and generalizability. RE is also able to model context, including variables that are only measured at the higher level [19]. Unlike fixed effects estimator, RE estimator does not automatically drop the time invariant regressors [20].

2.1. Sources of data

Data on Malaysia's companies supply to Global Fund is obtained from the GFATM Price and Quality Reporting, with the earliest data on Malaysia's supply in 2008. Data on female condoms were not included as the data were very scarce. The individual companies were named in the report, and the author compared the list of sheath contraceptives listed by MREPC to filter out non-Malaysian companies (refer Table 1). The data on fragile states, HIV prevalence, and distance between Malaysia and recipient countries are from World Bank [18] and Centre d'Études Prospectives et d'Informations Internationales (CEPII) [21].

One main weakness of Global Fund data is that the report is based on submission of data by principal recipients that have chosen to report via the Price and Quality Reporting and it is not independently verified [8]. For example, in the dataset for this study, one of the reports shows that the country is reported as Zanzibar, which is a semi-autonomous region of the country of Tanzania. As no other details (for example, information on price and quantity) are potentially to have error, the observation is maintained and grouped under Tanzania.

3. Results and Discussion

Table 2 shows the correlation matrix table. Given the high correlation between $\ln(HIV)$ and $AFRICA$ at 0.648, these two independent variables were estimated separately. Other variables did not show potential of

Table 3. Descriptive statistics of the annual average price and quantity reported.

	Average Price (USD)			Quantity Reported (Pack)		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
2008	0.02	0.05	0.02	10,800	13,536,000	1,576,026
2009	0.02	0.16	0.03	2,970	14,400,000	1,362,202
2010	0.02	0.07	0.03	79,200	41,760,000	5,977,690
2011	0.02	0.60	0.06	35,000	28,000,000	4,670,424
2012	0.03	0.74	0.07	936	16,092,000	2,447,839
2013	0.02	0.13	0.04	1,000	43,200,000	2,896,217

Source: Author's calculation based on data from Global Fund Price and Quality Reporting

Table 4. Results of country characteristics.

Explanatory variable: $\ln(C_{ij})$		
Variable		
$\ln(\frac{P}{1000})$	-0.081790	-0.031297
	(0.1873)	(0.6220)
$\ln(\frac{HEALTH}{n})$	-0.082166	0.132450
	(0.8796)	(0.8015)
FS	-0.276262	0.302790
	(0.5761)	(0.5035)
$AFRICA$	1.441332^{***}	
	(0.0024)	
$\ln(HIV)$		0.471351^{***}
		(0.0002)
C	11.41473	11.41614
R^2	0.223715	0.307608

Note: The values in the parentheses are the probabilities of rejecting the null hypothesis of significance. The symbols of ***, ** and * indicates the rejection of null hypothesis at 1%, 5% and 10% significance level respectively.

multicollinearity problem. Table 3 shows the descriptive statistics of the annual average price and quantity reported.

The mean average unit price of condoms supplied by Malaysian companies to Global Fund has not varied much between 2008–2013. The average cost was the lowest at USD0.02 in 2008, and progressively rose, and was at the highest at USD0.07 in 2012. However, the mean unit cost dropped to USD0.04 in 2013. The average unit cost drop was also observed in past literature [8]. There is also little trend in terms of mean quantity of condoms (pack) reported. The lowest mean quantity was in 2009 at 1.4 million packs while the highest quantity (pack) reported was 6.0 million in 2010.

In terms of country characteristics, HIV prevalence and African countries were significantly positive. The relationship between higher demand of condom with HIV prevalence is clear as condom is a device for prevention and infection control. Higher awareness also stems from the higher awareness to do HIV testing. Being an African country is significant positive also shows Malaysian companies condom supply is significant in areas where condom gap is significant as previously highlighted [13] (Southern Asia, and Middle and Western Africa).

On the other hand, being a fragile state (World Bank classification), health expenditure per capita and number of physician per 1,000 people were insignificant. On health expenditure per capita and number of physicians per 1,000 people (also a variable in past studies [4]), they were not significant possibly due to the use of sheath contraceptives for prevention control but used directly for medical treatment purpose.

For product characteristics, average quantity divided by distance between Malaysia and recipient country and average unit price of below USD0.07 were significantly positive. The higher quantity for further distance of the supplies may indicate suppliers' readiness to only tender for higher quantity required due to higher transportation cost. Average unit price of below USD0.07 were significant but average unit price of below USD0.02 were insignificant. These average price selection (USD0.07 and USD0.02) were based on past literature of procurement for Global Fund [8]. The insignificant result of below USD0.02 was initially expected as it was below the average price of Malaysia's export of sheath contraceptives of USD0.02–0.20 between the years 1989-1996 and 1999. Besides that, it was also below the average price

Table 5. Results of product characteristics.

Explanatory variable: $\ln(C_{ij})$		
Variable		
$\ln(\frac{Q}{D})$	0.754127*** (0.0000)	0.732425*** (0.0000)
$\frac{C}{Q}0.07$	-1.755045*** (0.0020)	
$\frac{C}{Q}0.02$		-0.198077 (0.6099)
C	9.307057	7.812429
R^2	0.590822	0.535689

Note: The values in the parentheses are the probabilities of rejecting the null hypothesis of significance. The symbols of ***, ** and * indicates the rejection of null hypothesis at 1%, 5% and 10% significance level respectively.

of USD0.03 of Karex's.

In summary, the significant product characteristics for Malaysian companies supply of condom to GFATM recipients are HIV prevalence and being an African country. For product characteristics, average quantity divided by distance between Malaysia and recipient country, and average unit price of below USD0.07 were significant.

4. Conclusion

The increased analysis and discussion of these country and product characteristics based on data on public domain (for increased transparency) has noticeable effect towards more efficient supply process. Suppliers or aspiring suppliers may supply condoms for social cause to the recipients in countries that need them at product characteristics most required, thus also contribute to more efficient tender and supply process. A perspective from the suppliers' side also provides further discussion to previous studies that analysed GFATM purchases and procurement. Previous discussions [8, 14] have also highlighted that greater discussion and analysis of Global Fund procurement and unit prices provides input for better decision making, and more efficient used of funds to tackle the issue of HIV/AIDS especially in low and middle-income countries.

A noticeable limitation of this study is the ability to only identify Malaysian companies (based on data from MREPC) and not other supplier from other countries, respectively. More discussion on Global Fund procurement and supplies can be explored either in terms of grant recipients or in terms of allowing suppliers to understand the needs of recipients. As more companies obtain better clarity of the needs and the characteristics of products and recipient countries, a more efficient supply of condoms and other medical devices under GFATM and other aid organisations can take place, which will finally benefit the target recipients.

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Appendix

Table 6. List of recipient countries in the supply of contraceptives by Malaysian companies, 2008–2013.

Albania	Mauritius
Armenia	Mongolia
Bangladesh	Morocco
Bolivia	Myanmar
Bosnia & Herzegovina	Nicaragua
Bulgaria	Niger
Burundi	Pakistan
Cambodia	Panama
Cape Verde	Paraguay
Central African Republic	Philippines
Colombia	Russia
Congo	Rwanda
Gambia	Serbia
Guatemala	Sierra Leone
Guinea	Swaziland
Guinea-Bissau	Tajikistan
Guyana	Tanzania
Honduras	Thailand
Indonesia	Togo
Iran	Tunisia
Kazakhstan	Ukraine
Macedonia	Uzbekistan

Source: Author's compilation based on data from Global Fund Price and Quality Reporting
Note: Arranged according to alphabetical order

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The development of organic agrotourism route connection in Ban Hua Ao Community, Sam Phan District, Nakhon Pathom Province, to promote tourism potential

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Abstract

This study aimed to 1) study the tourism-related contexts of Ban Hua Ao Community in Nakhon Pathom Province, Thailand, and its connected areas, 2) study the agrotourism potential of Ban Hua Ao Community, and 3) develop connecting tourism routes for organic agrotourism according to the supply chain of organic products. This study adopted the method of qualitative research. Data were gathered by means of in-depth interviews with 20 people who were involved in Ban Hua Ao tourism. These people were divided into 5 groups: the community leaders, the local entrepreneurs, the residents, the public and private agencies, and the tourists. This study employed content analysis to analyze the data.

The study found that Ban Hua Ao Community is known for its organic agricultural practice, which it uses to promote tourism. Ban Hua Ao Community shows great potential in all of the 5 respects of agrotourism potential. These are physical and biological landscape value; knowledge, wisdom and innovation value; tourism resource management potential; service potential; and potential to attract tourists. Finally it was found that the tourism route connection can be developed employing the concept of supply chain.

Keywords: Tourism route development, agrotourism, tourism potential
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1. Introduction

The government's national strategy to develop the country's economy and promote sustainability includes tourism industry development. (The twelfth national economic and social development plan 2017–2021) [1]. Evidently, tourism industry is one of the major economic factors of Thailand. In 2015, the country's tourism revenue amounted to 2.23 trillion baht, about 1.44 of which came from foreign tourists, while the other 0.79 from the native ones (The national development plan for tourism 2 Year 2017–2021) [2]. Tourism industry also helps to attract investment, create more employment opportunities, enhance income for local people, as well as raise the living standards of people in such region [3].

The global tourism trend nowadays is responsive to the change in economics, society, and culture. Most of the tourists put emphasis more on what they have learned and the experience they have gained during their travel. The kinds of tourism which suit their interest are special interest tourism, experimental tourism, and creative tourism. The point is to experience the actual local way of life rather than to merely visit tourist attractions. In this respect, it becomes essential that, with the cooperation of the local people, new types of tourism be developed which are in accordance with the new demand, (The twelfth national economic and social development plan 2017–2021) [1] for example, cultural tourism, health and wellness tourism, and agrotourism.

In Thailand, agrotourism is gaining popularity. It has become a new channel through which the farmers can directly communicate with tourists and add more value to their product, avoiding the exploiting merchant middlemen and earning more money in times of falling crop price. This kind of tourism responds to the present tourism demand well. It serves to educate tourists about agriculture, the local way of life, and the local community identity [4]. Agrotourism which deals with organic agriculture receives better attention because, at present, more and more tourists become interested in safe and chemical-free products.

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Ban Hua Ao Community, Sam Phran District, Nakhon Pathom Province, is one of the communities which are distinguished for their organic agriculture. People in the community joined hands in developing local agrotourism, which was based on the sufficiency economy model. The community has made ready their tourist attractions, tourism activities, and tourism products. However, most of the income is limited only to some parts of the community. This is due to the lack of tourism route connection, leaving tourists to travel without guided direction. The result is that tourists will neither be able to properly engage in the local way of life nor gain more memorable experiences. The researcher team recognized this problem and was interested in developing a connecting tourism route for organic agrotourism in Ban Hua Ao Community to help tourists understand more about organic agriculture as well as to promote cooperation among local tourism attractions. The concept of supply chain was adapted in order to develop the tourism route connection. The development aims to further the potential of the community's organic agrotourism, leading to local agrotourism tourism success.

2. Research Objectives

1) To study the tourism-related contexts of Ban Hua Ao Community and its connected areas.

2) To study the potential of agrotourism in Ban Hua Ao Community.

3) To develop tourism route connection for organic agrotourism according to the concept of supply chain.

3. Conceptual Framework

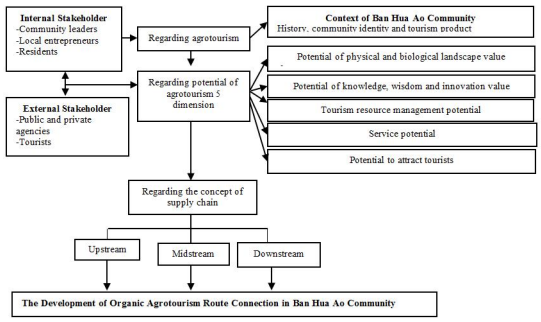

Figure 1: Conceptual framework of Development of Organic Agrotourism Route Connection in Ban Hua Ao, Nakhon Pathom.

4. Literature Review

4.1. Regarding agrotourism

Agrotourism is a type of tourism focusing on tourists learning and engaging in the local way of agriculture. The farmers will gain more income; while the tourists, better understanding about agriculture, pleasure and relaxation, and environmental awareness [5]. Agrotourism consists of 4 major activities: 1. Agricultural demonstration, e.g., how to grow mushrooms and how to make value-added products; 2. Education, e.g., making tourists understand more of an organic farm; 3. Local product selling; and 4. Introduction to agricultural business [6].

4.2. Regarding organic agriculture

Organic agriculture refers to an agriculture system which promotes biodiversity and seeks to maintain the ecological balance during production. Prioritizing consumer's well-being and the environment, it is a system which shuns the use of chemicals and synthetic substances while strongly advocates for sustainability [7].

4.3. Regarding the potential of agrotourism

The potential of agrotourism comprises 5 respects, that is, 1) physical and biological landscape value, 2) knowledge, wisdom and innovation value, 3) tourism resource management potential, 4) service potential, and 5) potential to attract tourists [8].

4.4. Regarding tourism route connection

Tourism route connection refers to the establishment of routes for the convenience and safety of tourists. These routes can be travelled either by foot, personal car, or other modes of transportation available. They can be ones which are normally used in daily life or ones which are specially designed for tourism purposes. The routes can be divided into 4 main groups: 1) urban tourism routes, 2) historical tourism routes, 3) natural tourism routes, and 4) integrated routes [3].

4.5. Regarding the concept of supply chain

Organic agricultural supply chain comprises processing stages of upstream, midstream and downstream. First comes the upstream stage, dealing with farmer's crop supply and quality control. Next is the midstream stage, dealing with the product-sorting and value-adding processes. Lastly, the downstream stage deals with the distribution of the product and responds to the consumer's demand [9].

5. Research Methodology

This study adopted the method of qualitative research with 3 stages of progress as follows:

Stage 1: Study of tourism-related contexts in Ban Hua Ao community, Sam Phran District, Nakhon Pathom Province, through document research and in-depth interview.

1.1 Researchers conducted a survey on related documents, researches, and studies regarding agrotourism

Table 1. Agrotourism potential, respect 1: physical and biological landscape value.

Respect 1: physical and biological landscape value
Scenery of agrotourist attractions
- The community has clear and orderly division of organic agricultural areas.
- Rich agricultural and natural attractions include rice field, fruit orchard, vegetable field, river, canal, etc., which perfectly reflect the local's agricultural way of life.
Climate of agrotourist attraction region
- The local climate can be divided into three seasons: hot (February-May), rainy (May-October), and cold (October-February), with the temperature running between 18-38 °C.
Variety of agricultural products
Bah Hua Ao's agricultural products can be classified into 3 groups, as follows:
1. Organic agricultural products, for example, guava, mango, banana, nam hom coconut, lime, and baby jackfruit.
2. Processed agricultural products, for example, baby jackfruit-made soap, herbal shampoo, crispy banana snack, guava juice, and baby jackfruit juice.
3. Other products, for example, fish sauce, herbal repellant, and organic fertilizer.
Remarkability and approval of agricultural products
- Ban Hua Ao's agricultural products are certified by the Organic Agriculture Certification Thailand in accordance with ACT Organic standards.
- Ban Hua Ao's agricultural products are approved by various retails and are distributed in Tops Supermarket, Sook Jai market, local hotels, hotels in Bangkok, etc.
Chemical-free production process
- The production does not permit the usage of chemicals at any time, from the upstream stage to the downstream stage.
Awards and certificates
- Sufficiency Economy Community Model Award in 2007, conferred by HRH Sirindhorn.
- Yoo Yen Pen Sook Community Award in 2015
- Outstanding Farmer Award in fruit orchard farming, second runner-up, by the community leader.
- Organic agriculture system certified by IFOAM
- Organic agricultural products in accordance with ACT standards
Waste management
The waste management system mainly deals with 2 types of waste:
1. Waste which can be recycled can be exchanged at the community learning center for selective products, including egg, fish sauce, and oil.
2. Food waste will be kept in a fermenter bucket and will be turned into organic fertilizer.
Agricultural product value
- Ban Hua Ao's agricultural products are 100% chemical-free and are one of Nakhon Pathom's local specialty.
- Organic agriculture serves as a means by which local wisdom and local way of life are preserved. It also increases the local people's income and, therefore, improves their quality of life. The knowledge can be passed down to next generations for further development in the future.
Study on the development of crop species
- The local people collaborated in studying and experimenting in order to develop better organic farming practices as well as quality crop species.
Tourist safety
- Tourism activity and route safety are ensured by the community staff stationing at every place of attraction.
Sustainable agriculture
Ban Hua Ao's sustainable agriculture is supported by its organic agriculture and the adaptation of sufficiency economy theory. In terms of economics, organic agriculture can support the local financially. In terms of culture, the cooperation of the community members helps to preserve the local way of life as well as further develop their inherited wisdom. In terms of environment, organic agriculture teaches one about the value of natural resources and promote the sufficient use of them.

potential, tourist behavior studies, and tourism route development. The data were obtained from a variety of secondary resources and were further analyzed to develop the questionnaire for interview.

1.2 Using the above-mentioned questionnaire, researchers conducted in-depth interviews with 20 informants who were involved with agrotourism in Ban Hua Ao Community. They were divided into 5

Table 2. Agrotourism potential, respect 2: knowledge, wisdom, and innovation value.

Respect 2: knowledge, wisdom, and innovation value
Innovative body of knowledge about agriculture
- Ban Hua Ao Community developed and implemented agricultural knowledge which suits its local way of living, for example, ditch fish farming, organic agriculture, tree bank, organic fertilizer making, community mill, and soilless lime planting.
Wisdom and identity
The body of knowledge regarding agriculture in Ban Hua Ao Community reflects local wisdom and identity. It is characterized in these 3 stages of production: 1. Planting: the use of chemicals is not allowed. Instead, organic approaches are preferred, for example, the use of bitter herb to repel insects. 2. Harvesting: vegetable fields and fruit orchards must have water trenches. When harvesting, the local will use a foam boat to travel on the water trench. 3. Processing: some crops are processed to add value to the product. The training is available to the local and the public alike at the community learning center.
Development of agricultural technology
- Ban Hua Ao developed an herb boiler and a fruit extractor to help with product value addition. - Ban Hua Ao developed a rice mill machine to add more value to its rice crop.
Sufficiency economy and local wisdom
Bah Hua Ao community adapted the sufficiency economy philosophy and applied to their agricultural practices and way of life. The theory comprised 3 components as follows: 1. Moderation: the local people should be moderate towards their production and refrain from using chemicals. They should aim for the quality of the product not the quantity. 2. Reasonableness: the local people should try to apply their inherited wisdom with modern knowledge and technological advancement to further their organic agricultural practice. 3. Self-immunity: the community can provide for itself and has awareness of the effect of its actions upon society, economy, and environment. The community should be willing to pass on its knowledge and wisdom to those who express interest. Its members should uphold agricultural ethical codes regarding their practice in organic agriculture.
Community network
Ban Hua Ao community is part of Sam Phran Model Project, which solidifies a cooperation between the Office of Non-formal Education, Subdistrict Agriculture Agency, Subdistrict Administrative Organization, Provincial Agricultural Office, and Bank for Agriculture and Agricultural Cooperatives.
Learning center for visitors
- The community shares their knowledge about organic agriculture, every process of the production, with visitors, domestic or foreign alike, and those who take interest in the subject. It was also chosen by Prime Minister Prayuth to be the visiting site for Myanmar's officials who came to learn about organic agriculture.

groups: the community leaders (3 people), the local entrepreneurs (5 people), the residents (5 people), the public and private agencies (3 people), and the tourists (4 people) with selecting purposive sampling group.

1.3 The validation of data was done through the technique of triangulation, including data triangulation, investigator triangulation, and theory triangulation.

Stage 2: Study of the potential of agrotourism in Ban Hua Ao Community

Researchers synthesized the 5 respects of agrotourism potential, the analyzed data acquired in stage 1, and the information obtained from other related studies to develop the questionnaire for interview. The 5 respects of agrotourism potential comprises 1) physical and biological landscape value, 2) knowledge, wisdom and innovation value, 3) tourism resource management potential, 4) service potential, and 5) potential to attract tourists.

Researchers collected data by conducting in-depth interviews with 20 informants who are involved with agrotourism in Ban Hua Ao Community. They were divided into 5 groups: the community leaders (3 people), the local entrepreneurs (5 people), the residents (5 people), the public and private agencies (3 people), and the tourists (4 people). The study employed triangulation approach for data validation and used the method of content analysis to analyze the validated data.

Stage 3: Development of organic agrotourism routes in Ban Hua Ao Community to enhance its agrotourism potential

Having studied the tourism-related contexts and tourism potential in Ban Hua Ao Community, researchers developed the questionnaire which was used in in-depth interviews with 20 people who were in-

Table 3. Agrotourism potential, respect 3: agrotourism resource management potential.

Respect 3: agrotourism resource management potential
Administrative structure and tourist attraction development plan
- Ban Hua Ao Community established the organic agriculture community group, joined by the local people, the community leaders, the Village Committee, the Village Woman Development Committee, and the local volunteers. The Ban Hua Ao's organic agriculture learning center was founded. Khun Prayad Pancharoen serves as the president of the center.
Systematic Area Organization
- Ban Hua Ao Community divided areas for planting each crop in organized arrangement with each section prepared with a learning station to welcome and give information to visitors.
Tourist safety
- There is no well-organized safety system.
Maintenance of public facilities and tourism resources
- Government agencies provide support in the maintenance of public facilities, such as, road maintenance and electricity and water supply management.
Income and employment
- Organic agriculture creates more jobs and incomes for the local people, whether from the tourist or the distribution of agricultural products (to Tops Supermarket, Sook Jai market, local hotels, hotels in Bangkok, etc.).
Networking to support tourism
Ban Hua Ao Community received support from the Office of Non-formal Education, Subdistrict Agriculture Agency, Subdistrict Administrative Organization, Provincial Agricultural Office, Bank for Agriculture and Agricultural Cooperatives, and local entrepreneurs, in supporting tourism. Still, it lacks the cooperation and networking between each place of attraction.
Natural resources and environment conservation
- Ban Hua Ao Community practices organic farming, free from chemicals, which produces no harm to the environment. More attempts at conservation are seen regularly, for example, the local river and canal cleaning day, when waste and water weed are collected from the water sources.
Time for tourism
- Tourists can visit the learning center round the year. Organic product market is open on Saturdays and Sundays.
Tourist number limitation for each area
- Tourist attractions in Ban Hua Ao Community can accommodate no more than 200 tourists each day.
Tourism PR
The modes of PR can be divided into 3 groups: person-to-person communication, online channel, and agriculture and tourism exhibition.
Sales promotion and agricultural product value addition
The practice of organic agriculture can add value to the product. Proper package design can help increase sales and mobilize goods distribution into remote areas.

volved with agrotourism in Ban Hua Ao Community. An area exploration in the community was also conducted.

Afterwards, the data obtained from the interviews and the exploration would be analyzed by the method of content analysis, summarized, interpreted, and synthesized in order to develop organic agrotourism route connection.

6. Results

1. Tourism-related contexts of Ban Hua Ao Community, Sam Phran District, Nakhon Pathom

Based on the data obtained from the interviews, there are 3 main, relevant contexts that need to be addressed: historical contexts, identity context, and tourism product context.

Historical context

Ban Hau Ao Community is located in Bang Chang Subdistrict, Sam Phran District, Nakhon Pathom Province, Thailand. In the past, there were streams flowing through the area. Various wild animals dwelled in this place, especially elephants. Herds of elephant regularly visited the place to find food, leaving only stomped lands in their wake. Many parts of the area then became spacious and open fields, thus the name "Hua Ao," which is still used nowadays.

Identity context Ban Hua Ao is an organic agricultural community, refusing to use chemicals in any production stages, whether in the upstream stage (e.g., soil preparation, fertilizer preparation, location prepa-

Table 4. Agrotourism potential, respect 4: service potential.

Respect 4: service potential
Travelling route
- There is no signpost which clearly gives direction to Ban Hua Ao community. Only a small signpost exists.
- The present asphalt pavement can facilitate the traveling. Road width extension is to be carried out to support greater number of tourists.
- To get to Ban Hua Ao Community requires personal car. No public transportation at the moment can be used to reach the area. **Tourist facilities**
- The restrooms at the community learning center are clean, clearly separated by gender, and can support the maximum amount of 200 tourists per day.
- Electricity and water supply are supported by public agencies.
- The parking lots are limited and cannot support too many visitors.
- No public phone or Wi-Fi service are available in the community's tourist attractions.
Tourism Staff
- The staff at the organic farming learning center is knowledgeable and capable of giving clear and useful information to the visitor.
- The community staff regularly gather to improve their skills and knowledge regarding agriculture and tourism.
- Young guide service is available.
- The number of staff is too small comparing to that of tourists.
Tourist reception
- The local people are friendly. A selective number of them was trained by public agencies to be amicable hosts, the skill which they afterwards shared with other residents.
Guide and local philosophers
- Young guide service is available on Saturdays and Sundays. The service is provided by the students of Ban Hua Ao School, who attended a community young guide training course.
Local philosophers in the community can act as a guide and give information to tourists, for example, 1. Miss Prayad Pancharoen, who specializes in bio fertilizer, plant propagation, and plant hormone; 2. Miss Mont Choradon, who specializes in fruit processing; and 3. Mr. Chaya Pancharoen, who specializes in plant propagation by various means.
Services for seniors and people with disabilities
- There is no service for seniors and people with disabilities available at the moment.
Other available services and facilities in the community
- Organic agricultural production can be purchased at the community learning center.
- Food and drink services are available in the community.

ration), the midstream stage (e.g., crop harvesting, processing), or the downstream stage (e.g., marketing, product distribution). The community's organic practice was certified by the Organic Agriculture Certification Thailand. Its notable agricultural products are, for example, guava, mango, banana, nam hom coconut, lime, riceberry, and baby jackfruit, with its vegetable farms and fruit orchards standing remarkable as well.

Tourism product context

Notable tourism products of Ban Hua Ao Community include organic products, e.g., guava, mango, banana, nam hom coconut, lime, riceberry, and baby jackfruit; and learning activities about organic agriculture, e.g., organic fertilizer-oriented farm, fish ditch farming, organic fertilizer production, bug repellant making, and soil improvement. These products and activities can respond well to tourist's demand in agrotourism. They provide a true opportunity for the visitor to learn more about organic agriculture from the upstream to the downstream stages and to have an interaction with the local people which leads to the better understanding of their way of life.

2. Results concerning the study of agrotourism potential of Ban Hua Ao Community, following the concept of 5-respect agrotourism

3. Results concerning the development of connecting organic agrotourism routes in Ban Hua Ao Community to enhance its agrotourism potential

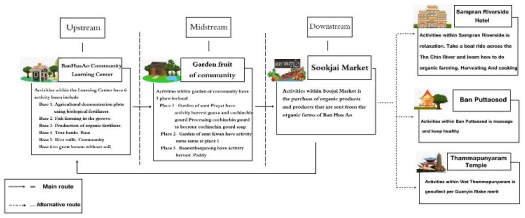

Figure 2: Shows the organic agrotourism routes of Ban Hua Ao Community.

From the study, it is found that the development of the connection between Ban Hua Ao's tourist attrac-

Table 5. Agrotourism potential, respect 5 potential to attract tourists.

Respect 5 potential to attract tourists
Variety of tourism activities The community learning center holds 6 learning stations, as follows: - Station 1: Organic fertilizer-based demonstrated fields - Station 2: Fish ditch farming - Station 3: Organic fertilizer making - Station 4: Tree bank - Station 5: Community rice mill - Station 6: Soilless lime planting
Engagement in agricultural activities - Tourists can participate in agricultural activities with the farmer, from the upstream stage of production to the downstream stage, for example, soil preparation, planting, harvesting, and product consumption.
Information service for tourists - Ban Hua Ao Community has a number of scholars specializing in organic agriculture, who can support visitors with agricultural knowledge. In the community learning center, each learning station offers lecture, demonstration, and learning activity.
Skill training and knowledge transfer - Specific skill training courses, for example, wooden handicraft and food processing, are available to the residents of Ban Hua AO Community to provide them an extra way of earning income.
Connection between tourist attractions in the inner part and those in the outer part of Ban Hua Ao Community Ban Hua Ao Community holds 1. tourist attractions in the inner part, e.g., Thumpanyaram Bang Muang Temple, Bang Chang Tai Temple, and Buddha O-sot Retreat; and 2) tourist attractions in the outer part, e.g. Sook Jai Market, Sampran Riverside Resort, Rai Khing Temple, Sam Phran Crocodile Farm, and Sam Phran Temple. Also, there are many other tourist attractions in the area but there is no proper networking and collaboration between each place.

tions, which fits the demand of the local people and the present tourism trend, should take into consideration the concept of supply chain regarding organic agriculture. The result concerns the learning of organic agriculture from the upstream stage, the midstream stage, to the downstream stage, as demonstrated in Fig. 2.

The development of organic agrotourism routes can be explained using Fig. 2, that is, the connection should be established between the tourist attractions of the upstream stage of production, of the midstream stage, and of the downstream stage. Alternatives tourist attractions within the community are additionally provided.

Tourist attraction of the upstream stage of production Ban Hua Ao Community Learning Center

The community learning center supports the learning of organic agricultural practice. The community adopted the sufficiency economy theory and integrated the ideas into the way of living. It received numerous awards, for instance, Sufficiency Economy Community Model Award in 2007, conferred by HRH Sirindhorn, and Outstanding Farmer Award in fruit orchard farming, second runner-up, and won by the community leader. This learning center is considered the most outstanding tourist attraction of the upstream stage, providing the information regarding soil preparation, seed preparation, sprout growing, organic fertilizer use, etc.

The community learning center holds 6 learning stations, that is, station 1: organic fertilizer-based demonstrated fields; station 2: fish ditch farming; station 3: organic fertilizer making; station 4: tree bank; station 5: community rice mill; and station 6: soilless lime planting. It also offers an activity to teach the learner about fundamental organic agriculture. Available organic products include guava, banana, mango, nam hom coconut, lime, riceberry, traditional Thai dessert, herbal soap, coconut broom stick, and a variety of local OTOP products.

Tourist attraction of the midstream stage of production local organic fruit orchards and vegetable fields

Ban Hua Ao Community's fruit orchards and vegetable fields are organic and chemical-free. Visitors can learn about crop harvesting and processing at these places.

Available activities are held at 3 places, that is, 1) guava orchard: tourists can participate in the harvesting of the fruit, learn how to tend the tree and its crop, as well as learn how to make guava juice; 2) rice field: tourists can participate in rice seedling transplantation, rice harvesting, and rice milling; and 3) baby jackfruit orchard: tourists can learn how to process baby jackfruit into juice and soap.

Available organic products include guava, guava juice, riceberry, baby jackfruit, baby jackfruit juice,

and baby jackfruit soap.

Tourist attraction of the downstream stage of production Sook Jai Market

Sook Jai Market is located in Sam Phran District, Nakhon Pathom Province. It offers various choices of organic products. It is considered one of the most suitable destination for the tourist looking for healthful goods.

Available activities are, for example, organic products shopping and eating.

Available products include organic fruit and vegetable, traditional Thai food and dessert, and a variety of processed products.

Alternative tourist attractions Sampran Riverside Hotel

Sampran Riverside Hotel promotes the learning of organic agriculture; it offers agriculture tour packages on Saturdays and Sundays.

Activities available inside the hotel are, for example, boat rowing tour and organic agrotourism learning (organic practices, crop harvesting, cooking, etc.).

The hotel is a distribution center of local products, including vegetable, fruit, and processed products. Also, Sook Jai Market is part of the hotel.

Thumpanyaram Bang Muang Temple

Another choice of visit, Thumpayaram Bang Muang Temple houses the largest statue of Yulai Chinese Buddha in Thailand. The temple also offers organic products and health services.

Available activities are, for example, Buddha statue worship, massage therapy, herbal foot spa, and sightseeing.

Available products include organic products, for instance, guava, rose apple, baby jackfruit, coconut, lime, and rice berry.

Buddha O-sot Retreat

Buddha O-sot Retreat is situated in Klong Mai Subdistrict, Sam Phran District, Nakhon Pathom Province. This place is a learning center of physical and mental health as well as offers accommodation service for tourists.

Available activities are meditation retreat and acupressure massage.

Available products are Buddha O-sot spray and organic herbs

7. Conclusion and Discussion

Ban Hua Ao Community is an organic agricultural community. Their agricultural practice involves no chemicals in every production stage, whether in the upstream stage (e.g., soil preparation, fertilizer preparation, location preparation), the midstream stage (e.g., crop harvesting, processing), or the downstream stage (e.g., marketing, product distribution). The community's organic practice was certified by the Organic Agriculture Certification Thailand. Its notable agricultural products are, for example, guava, mango, banana, nam hom coconut, lime, riceberry, and baby jackfruit, with its vegetable farms and fruit orchards standing remarkable as well. The community organizes numerous learning activities about organic agriculture, e.g., organic fertilizer-oriented farm, fish ditch farming, organic fertilizer production, bug repellant making, and soil improvement. These products and activities can respond well to the tourist's demand in agrotourism. They provide a true opportunity for the visitor to learn more about organic agriculture from the upstream to the downstream stages and to have an interaction with the local people which leads to the better understanding of their way of life. This is in accordance with the study by Teppagorn NaSong (2011) [6] mentioning that agrotourism is a rising trend; it provides an opportunity for tourists to gain knowledge through agricultural demonstration and engage in doing actual farming work. These activities promote conservation and add value to agricultural products.

Regarding the 5 respects of agritourist attraction potential, it is found that the community is remarkable in all the 5 respects, that is, 1) physical and biological landscape value: the community offers a variety of organic products, certified by Organic Agriculture Certification Thailand; 2) knowledge, wisdom and innovation value: the community developed organic agricultural body of knowledge which suits the community's way of life and can be put into practice for every stage of production, upstream to downstream, for example, organic fertilizer-oriented farming, fish ditch farming, organic fertilizer making, tree bank, and soilless lime planting; 3) tourism resource management potential: a community organic agriculture group was established to help provide services to tourists systematically, manage agricultural areas, as well as prepare the learning stations for tourists who are interested in organic agriculture; 4) service potential: the staff inside the learning center is knowledgeable about organic agriculture and is capable of educating visitors on this subject; and 5) potential to attract tourists: tourists can participate in agricultural activities from the upstream stage to the downstream stage, such as soil preparation, planting, and harvesting. In this regard, it is seen that the community has enough potential to attract tourists, which is in accordance with the study by Rattanapol Yodkeaw and others (2017) [10], saying that organic agrotourism in Ban Hua Ao Community has great potential, considering its tourism resources, tourism activities, tourist attraction accessibility, and tourist facilities.

Regarding the development of agrotourism route connection, the learning of organic agriculture from the upstream stage, the midstream stage, to the downstream stage that is, the connection should be established between the tourist attractions of the upstream stage of production, of the midstream stage, and of the downstream stage. Alternatives tourist attractions within the community are additionally pro-

vided as following; tourist attraction of the upstream stage of production is Ban Hua Ao Community Learning Center which supports the learning of organic agricultural practice with the sufficiency economy theory with 6 learning stations. Next, tourist attraction of the midstream stage of production is Local organic fruit orchards and vegetable fields with chemical - free and tourists can participate in some activities at 3 places, that is, 1) guava orchard 2) rice field and 3) baby jackfruit orchard. Furthermore, tourist attraction of the downstream stage of production compose of Sook Jai Market for the tourist looking for healthful goods. Moreover, there are alternative sites like Sampran Riverside Hotel for offering agriculture tour packages on weekend, Thumpanyaram Bang Muang Temple and Buddha O-sot Retreat. The development is in accordance with the Logistic Development Strategy and the concept of agricultural supply chain [11], which proposed that agricultural supply chain comprised the upstream stage, the midstream stage, and the downstream stage of production. Nontipak Pianroi and others (2013) [12] also supported the connection development idea, mentioning that tourism route connection can effectively promote a community's tourism marketing and draw greater number of tourists.

8. Suggestions

Regarding the application of the study's results

Ban Hua Ao Community can adopt the study's results to develop connecting tourism routes to enhance its tourism potential and to provide tourists with better experience and knowledge about organic agriculture.

Regarding future study

This study focused on Ban Hua Ao Community's selected contexts, tourism potential, and tourism route connection. Other aspects are still left unexamined, which can be further investigated, for example, community PR, human resource development, and tourism strategy, all of which play a significant role in promoting organic agrotourism in Ban Hua Ao Community, one of the most remarkable and notable places of Nakhon Pathom Province.

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Risk factors causing sexual crimes

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Abstract

This paper is about sexual crimes which are considered one of severe social problems that has a serious impact against the society, and there should be a study to find prevention methods urgently. The purpose of this study aimed to study the risk factors causing sexual crimes according to Crime Triangle Theory and Sexual Crime Prevention Methods. As the result, it was found out that risk factors causing sexual crimes could be categorized into 3 elements; perpetrator, victim and opportunities. However, the element causing the most sexual crimes in this study was opportunity; i.e., factors of being a close acquaintance, factors of scene which are often isolated areas, and factors of time which often occur at night to late night. Followed by an element of perpetrators which is caused by factors that perpetrators often use drugs. The suggestions for preventing sexual crimes are as follows. Relevant agencies must encourage people to have knowledge of self-defense skills. Family institutions and educational institutions must provide knowledge about sexual crime prevention and should include knowledge about sexual crimes in the educational curriculum. There should be more measures to monitor the safety of all areas. As well as the community participation on crime prevention, the media must have responsibility towards the society in presenting various media, media control, and the operational integration of all sectors.

Keywords: Risk, factors, sexual crimes

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1. Rationale

This paper has motivation from sexual crimes situation which is the problem causing the losses to victims in terms of physically, mentally, socially, and emotionally. In some cases, sexual crimes may cause property damages including the severe losses of life. According to the aforementioned consequences, remedies must be made for victims because some may have to deal with traumas in their mind for the rest of their lives. This problem is also as important as other social problems, and it is likely to be more severe every year. As can be seen from the statistic of violence against women and children of Ministry of Public Health, it indicates that the tendency is likely to increase as it is found that that children and women were abused every 15 minutes, averagely 4 persons per hour [1]. There are 2,259 cases for statistic of rape and abuse reports [2]. Also, a statistic only in August 2018, there are 198 cases for rape reports from Counter Crime Planning Division, Strategy Division Office of Police Strategy, Royal Thai Police (Royal Thai Police, Strategy Division Office of Police Strategy, [3]. However, Royal Thai Police also indicates that numerous sexual crimes are still underreported in Thailand because victims are afraid to report, feel shame, fear of disgrace and losing reputation due to social contexts and culture of Thai society. That is the reason why this problem needs an urgent solution as well as the development of effective sexual crime prevention systems for the welfare and safety of the people. Therefore, the study of the factors causing sexual crimes will be beneficial to people. Most research studies pay attention to sexual offenders. Information reflects that the causes of associating with friends who have inappropriate behaviors, viewing pornographic media, drinking alcohols [4, 5] are the major causes of sexual crimes. Regarding of victims, most of the victim's bases are incomplete family and poverty [6]. The researcher wanted to apply Crime Triangle Theory which is commonly used in the crime prevention and suppression in order to have more comprehensive analysis of risk factors for sexual crimes. The knowledge gained can be applied to avoid and prevent problems before problems occur which can lead to unpredictable mental and physical losses, leading to the destruction of security of the society.

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2. Objectives

The purpose of this study aimed to study the risk factors causing sexual crimes and methods to prevent sexual crimes.

3. Methodology

The methodology of this study was a research synthesis from research papers and theses that are related to the factors and causes of sexual crimes by means of quantitative synthesis using frequencies and percentage values and lecture with the results of the synthesis. The selection processes were as; first, the researcher searched for research papers on the internet on the websites of libraries of higher education institutions by using key words; such as "sexual crime" "sex offense" "rape" for the search, after that, the researcher searched for complete, credible and quality research documents by evaluating preliminary research, and there are total 12 research topics which have the following details;

Research Topic #1 - The study by Uea-amnuay [7]: The Research of Risk Factors towards Being a Victim of Sexual Crimes among Thai Women.

Research Topic #2 - The study by Sophondirekrat [8]: The Research of Causes of Sexual Harassment among Female Students Caused by Nightlife in Bangkok and Perimeters.

Research Topic #3 - The study by Woranetipho [9]: The Research of Causes of Being Rape Victims among Children: Case Study in Specific Areas in the Area of Responsibility of Office of the Attorney General, Juvenile and Family Case Section.

Research Topic #4 - The study by Chuchuenklin [6]: The Thesis of Family Conditions and Social Environments Causing Children to Become Victims of Sexual Crimes: Case Study on Children Who Have Become Victims of Sexual Crimes Who Receive Service in Police General Hospital.

Research Topic #5 - The study by Yimyaem, Tiansawat, and Chaiwut [10]: The Study for Articles of Sexual Abuse and Domestic Violence in Women's Family in the Workplace.

Research Topic #6 - The study by Kaeonui and Thammarangsee [4]: The Research of Sexual Harassment Behavior among Children and Juvenile under the Influence of Alcohol Consumption.

Research Topic #7 - The study by Suriyamanee and Lerttomarasakul [11]: The Research of the Analysis of Factors Related to Sexual Abuses: Case Study of Rape and the Abuse against Female Victims among Children and Juvenile in the Integrated Theory Context.

Research Topic #8 - The study by Phadungthiti [12]: The Thesis of Pornography and Sexual Offenders.

Research Topic #9 - The study by Tangchaiwattana [13]: The Thesis of Family Factors Causing Sexual Abuses against Girls by Family Members.

Research Topic #10 - The study by Jaikwang [14]: The Thesis of Social Factors towards Child Rape by Male Detainees: Case Study on Udon Thani Central Prison.

Research Topic #11 - The study by Moontichai [15]: The Thesis of Social Environments towards Severity of Sexual Offences among Children and Juvenile.

Research Topic #12 - The study by Inthawiwat [16]: The Thesis of Factors Related to Violence in Committing Sexual Crimes: Case Study on Prisoners of Rape Cases.

4. Concepts and Theories in This Study

Sexual crime is an offense involving sexual offenses. There are characteristics that violate the customs, traditions and law as victims do not consent. There are actions using forces of molestation, called rape, immoral conduct and sexual abuse.

Crime Triangle Theory can be applied to describe the causes or elements of crimes. However, Clarke and Eck [17] mentioned about the elements of Crime Triangle as follows;

1) Offender means a person who has the desire to cause the act or commit crime.

2) Victim means a person, a place, or an object which an offender or criminal intends to commit crime against or a target desired by an offender.

3) Opportunity means time and place appropriate for an offender or criminal to be able to commit an offence or a crime.

A crime can be easily committed once all of the aforementioned elements are complete. This theory presents a concept of solving crime or preventing crime by omitting one of the elements of the crime triangle to be missing, then, crime will not occur or will be difficult to occur.

The study of risk factors causing sexual crimes has applied the Crime Triangle Theory because this Crime Triangle Theory is a theory that explains the causes or compositions of the crime, making us understand the compositions of the factors of sexual crime easily. By studying and analyzing the data from the offenders and the victims in the past crimes, both in the process of prosecution and the judgment process which has ended, it was found that the factors of sex crime can be divided into 3 major factors which consist of; the offender, the victim and the opportunity. When the risk factors for sexual crimes are obviously seen, the concepts from this theory can be applied to analyze and use to formulate strategies in order to solve the problems of sexual crimes more efficiently, concretely, appropriately for the conditions that are at risk of sexual crimes, which is a social problem that has serious consequences for both victims, family and society.

Table 1. Risk factors causing sexual crimes.

Research*	1	2	3	4	5	6	7	8	9	10	11	12	Total	Percent
Factor														
Offender Element														
- Substance abuse	✓		✓		✓				✓	✓	✓		6	50.00
- Low income	✓							✓	✓	✓		✓	5	41.67
- Being stimulated by media			✓			✓		✓		✓	✓		5	41.67
- Broken family								✓	✓	✓			3	25.00
- Specific personality						✓			✓		✓		3	25.00
- Male oriented idea	✓								✓				2	16.67
- Risk lifestyle						✓					✓		2	16.67
- Being provoked by friends						✓							1	8.34
Victim Element														
- Alcohol abuse	✓	✓					✓						3	25.00
-Precarious dress	✓	✓	✓										3	25.00
- Incomplete and broken family				✓					✓				2	16.67
- Low income			✓	✓									2	16.67
-Teenager	✓	✓											2	16.67
-Good looking and attractive appearance	✓		✓										2	16.67
-Having had sexual intercourse			✓										1	8.34
Opportunity Element														
- Trust and intimacy	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	10	83.34
-Staying in secluded area and away from people	✓	✓	✓	✓	✓					✓	✓	✓	8	66.67
-Crimes occur at night to late night	✓	✓	✓		✓		✓		✓	✓			7	58.34

***Remark:** Research and thesis titles appear in the Reference Section.

5. The Results

5.1. Risk factors causing sexual crimes

Once the researcher analyzed factors related to sexual crimes, the researcher found all the results of the study (as shown in Table 1), and divided the risk factors causing sexual crimes according to various elements from the Crime Triangle Theory in all 3 aspects. The results are as follows;

1) Offender element. It is found that most of sexual crimes are caused by substance abuse (50%); followed by low income or low economic status and acquiring sexual stimulation from media (41.67%); followed by problems in family or family breakdown or specific personality (25.00%); such as being a person who loses control of oneself, lack of confidence, depression, repression; followed by the factor of male-oriented social value and living a life in risky manner (16.67%) and lastly being encouraged by friends (8.34%).

2) Victim element. It is found that the most risk factor of the victim is; the victim is in a state of intoxication and dresses in precarious dress on the day of the incident (25.00%); followed by the nature of the victim lives in an incomplete and broken family, has a low economic status, and the victim is in an age of teenager with attractive appearance (16.67%), and the last factor is that the victim had sexual intercourse earlier.

3) Opportunity element. It is found that the most risk factor is the close relationship between the offender and the victim (83.34%), followed by the factor of being amidst risk environment, i.e., secluded area and away from people (66.67%), and the last factor is an opportunity of crime occurrence is during the night and late night (58.34%).

6. Suggestions and sexual crimes prevention

The researcher suggested that the approach of solving sexual crimes should be emphasized for all citizens, communities, and all social institutions to be jointly responsible for their own safety and in various areas because only police officers cannot manage all aspects of social problems. Taking care of their own safety and society should be the responsibility of all people, not by any specific organization. According to this idea, the researcher therefore proposes the guidelines for the prevention of sexual crimes as follows;

1. Strengthening the public is essential because sexual crimes may be an unexpected threat to the public. The offender may be both a stranger and a familiar acquaintance. Having self-defense skills for survival from bad situations is extremely important.

2. Related institutions; such as family institutions and educational institutions should perform their role in teaching, providing knowledge and understanding to people about sexual crimes in order to allow people to be aware of their attitudes and behaviors towards opposite sex and should not trust opposite sex too much although such person is very close, as well as to be aware of how to avoid being in a secluded area and away from people, roaming in risky areas, visiting entertainment venue during nighttime, visiting to the opposite sex's room and avoiding intoxication, and always realizing that sexual crimes can occur to any person, anytime and anywhere.

3. Officials who work in relevant organizations must perform active roles in preventing many types of problems; such as campaigns, public relations, providing crucial knowledge and useful information for people in the public that they can use it to prevent themselves from being victims from sexual crimes; such as knowledge of sexual crimes, risk factors causing sexual crimes, for example, realizing that you must not be negligent to both acquaintances and strangers, avoiding going into secluded areas alone, leaving a house at night, refraining from using any type of substance, not dressing in precarious manner, and avoiding wearing jewelry and high-value items, etc.

4. Risk factors on locations that are secluded areas and away from people are considered environments that are vulnerable to crimes. Therefore, responsible agencies should adjust the environment to reduce the likelihood of crime occurrence, for example, building fences or obstructions to prevent the offenders from committing crimes, adjusting areas that are at risk of frequent crime occurrences to be open areas, Install light posts to allow people to have visibility of surrounding area clearly, installing surveillance cameras (CCTV), etc. and the seare solutions to prevent the occurrence of sexual crimes in the aforementioned areas.

5. Risk factors of time, according to the study, it is found that sexual crimes often occur at night or late night, therefore, agencies that are responsible for providing safety and security to people should have measures or policies to monitor those areas, especially during the night where crimes often occur.

6. Agencies who have responsibilities of crime prevention and suppression should have plans and policies for integrating operations by depending on community participation to participate in monitoring, preventing and resolving sexual crimes, as well as encouraging community members to monitor the occurrence of sexual crimes, for example, monitoring of individuals' or families' behaviors in communities that may be at risk of occurrence, setting up security guards to monitor the safety of the community, and jointly managing areas that are at risk of crime in the community in order to eliminate the chances of crime occurrence.

7. Agencies who have responsibilities of crime prevention and suppression should have integrated operations with every sector in order to improve the operation plans, protocols, measures, as well as to improve personnel plans, techniques, and equipment to be more efficient for the operations.

8. Nowadays, people in every age and every sex can access to information technology very quickly and easily. This matter is a difficult task to control. However, agencies who control of media broadcasting; such as radio and television broadcasting directing board must have more strict measures to control media in order to prevent the broadcasting of media that may provoke or stimulate and lead to sexual crimes.

9. There should be policies, laws, and measures to control the factors causing sexual crimes; such as various types of narcotics. Therefore, there must be laws or measures to control narcotics, for example, more strict measures or laws for selling alcohol to children and youth, having laws to prevent and suppress drugs and prostitution in serious manner in order to reduce the stimulation of crimes.

10. Focus on issuing measures or policies to reduce or control the number of offenders or criminals, which may focus on Law Enforcement Theory, for example, more stringent drug eradication and suppression policies encouragement, measures to control nighttime entertainment venues determination, and examination of locations which may be the risk of crime to occur more frequently.

7. Conclusion

Regarding to the risk factors causing sexual crimes, it is found that the risk factors that are at a high level consist of 4 factors. The component that causes sexual crimes the most is the opportunity factor, which consists of; 1) the factor of trust and relationship between the offenders and victims (83.34%) is the most important cause of sexual crimes from this study,2) the factor of environment, it is found that the risk would be much higher if the victim is in a secluded area and away from people (66.67%), and 3) the factor of time which most of sexual crimes occur at night to late night (58.34%). The offender element is also the factor that can be categorized as 4), mainly due to substance abuse (50.00%) which results in the offenders losing control of themselves which then leads to the cause of sexual crimes, while the element of victim is the least risk factor. Methods of sexual crimes prevention are as follows, strengthening the people to survive. Relevant institutions must have full roles and responsibilities, and the relevant authorities must proactively work to prevent sexual crimes by monitoring on secluded locations, especially during the night time. Crime suppression organizations should perform the integration of operations from all sectors and public participation by issuing policies, laws, and measures to control factors causing sexual crimes; such as substance abuse,

pornography, as well as issuing more restrictive measures or policies in order to reduce or control the number of offenders.

However, according to the result of this study, it will be beneficial if people apply this knowledge and information for their daily life in order to avoid and prevent the occurrence of sexual crimes before they lead to invaluable losses.

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Exploration of antibiotic usage pattern in dental professionals

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Abstract

To explore the antibiotic treatment pattern among dental professionals, who working in Dental hospital, Faculty of Dentistry, Mahidol University. A self-administered questionnaire was used in this study. The questionnaire was sent to dental professionals at Dental hospital, Faculty of Dentistry, Mahidol University. The questionnaire was included demographic data and pattern of antibiotic treatment and usage. Information was collected on the number and names of antibiotic and prescription data. All result was analyzed with descriptive statistics using Statistical Package for Social Science (IBM SPSS version 22, USA). 100% of dental professionals did not prescribe antibiotics to manage oral diseases in cases of halitosis and orthodontic treatment. More than 80% of dental professionals specifically prescribed antibiotics in cases of endodontic treatment, orofacial infections and surgical removal of impacted tooth, and more than 50% of dental professionals prescribed antibiotics in dental abscess (pericoronal abscess, dento-alveolar abscess and periapical abscess), extraction by open method, swelling condition, flap surgery and implant placement. But did not use antibiotics in simple tooth fracture, dental caries, apical periodontitis and dry socket. Regarding to the situation questions, it was found that 96.15% of dental professionals chose to prescribe Penicillin as the first-choice of localized infection and 100% of dental professionals prescribed Clindamycin in case of Penicillin allergy. Some of dental professionals potentially had a misconception in indications of antibiotics prophylaxis usage in congenital heart disease and prosthetic cardiac valve. There was still an irrational use of antibiotic within dental practitioners, which may lead to the issue of antibiotic resistance. Thus, the need for rational prescribing should be considerably for further developing of antibiotic usage program in Dental hospital.

Keywords: Antibiotic usage pattern, dental professionals, dental hospital
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1. Introduction

Rational use of medicines defines that "patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements for an adequate period of time, and the lowest cost to them and their community" [1] and can be performed by the 5 rights: right drug , right dose, right route, right time and right patient [2]. At present, antibiotics are important to treat infectious diseases. However, wrong, irrational, inappropriate or prescribing of antibiotic usage was the cause of antibiotic resistance. Some studies [3] stated that the urgent need to decrease proliferation of antibacterial resistant bacteria has refocused attention on the proper use of antibacterial agents. Through the World Health Organization announcement, this topic of antibiotic usage has also stated the slogan for antibiotic resistance as "Antibiotic resistance: No action today, No cure tomorrow", and has stressed for an international action for the resistance crisis since 2011 [4, 5].

Accordingly, antibiotic resistance is a major challenge for global health care. And dental professionals play a role to support the quality of antibiotic usage. Scientific literature evidence suggests that dental professionals are also prescribing increased 62.2% [6]. When prescribed rationally, antibiotics are beneficial in patient care. However, with this prescribing pattern, the widespread use of antibiotics, has led to development of antibiotic resistant in common antibiotic usage. As this situation , not only resistant case, irrational antibiotic usage also causes adverse side effects [7].

One of the deviations from common antibiotic usage in dentistry is antibiotic prophylaxis for patients with cardiac conditions and at risk of bacterial endocarditis. The American Heart Association (AHA) guidelines [8] focus on antibiotic prophylaxis for patients with the following:

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Table 1. Demographic and characteristic of respondents.

Characteristic	Number	%
Age (years)		
25-30	82	78.85
>30	22	21.15
Years of experience (years)		
0-5	72	69.23
6-10	18	17.31
11-15	8	7.69
>15	6	5.77
Area of specialization		
General Dentistry	26	25
Prosthodontics	4	3.8
Periodontics	4	3.8
Endodontic	14	13.5
Operative Dentistry	2	1.9
Orthodontics	2	1.9
Pediatric Dentistry	2	1.9
Oral and Maxillofacial Surgery	48	46.2
Oral and Maxillofacial Pathology	2	1.9

1. Prosthetic cardiac valves, including transcatheter-implanted prostheses and homografts.

2. Prosthetic material used for cardiac valve repair, such as annuloplasty rings and chords.

3. Previous infective endocarditis (IE).

4. Unrepaired cyanotic congenital heart disease or repaired congenital heart disease, with residual shunts or valvular regurgitation at the site of or adjacent to the site of a prosthetic patch or prosthetic device.

5. Cardiac transplant with valve regurgitation due to a structurally abnormal valve. However, there was a study [9] that found the compliance of dental professionals to the current guidelines seems not to be optimal, such as prescribing antibiotic prophylaxis in patients with stable angina which is unnecessary.

Exploration of scientific literature revealed very limited studies in Thailand. So, quantifying the impact of antibiotic treatment and usage pattern is necessary for dental practice improvements, as well as to develop measurable rational antibiotic usage program to report against the Antimicrobial Resistance Strategy. Thus, before developing the program, to assessing the antibiotic prescription pattern and resistance awareness among dental professionals are still needed.

According to further developing antibiotic usage program in the Dental hospital, Faculty of Dentistry, Mahidol University, it is formerly necessary to explore the incident of antibiotic treatment patterns among dental professionals. Hence, the aim of the study is to explore the antibiotic treatment pattern among dental professionals, who working in Dental hospital, Faculty of Dentistry, Mahidol University.

2. Materials and Methods

This study was a cross-sectional survey and conducted from December 2018 to January 2019. The respondents were dental professionals who work in special or departmental clinic in Dental hospital, Faculty of Dentistry, Mahidol University. Ethical approval was obtained from the Institutional Review Board of the Faculties of Dentistry and Pharmacy, Mahidol University with COE.No.MU-DT/PY-IRB 2018/050.0211.

2.1. Survey questions

The questions for the survey were developed and reviewed by antibiotic usage and resistance expert and clinical researcher for validity qualification. The survey respondents were asked to answer questions relating to the treatment of dental infection. The questionnaire consisted demographic variables of the respondents, and the questions pertaining to knowledge and practice of dental professionals before prescribing antibiotics (common antibiotic prescribing in each situation, clinical conditions for which antibiotics prescribing, awareness about antibiotic prophylaxis).

2.2. Survey administration

The questionnaires were delivered using an online survey. All responses (as dental professionals) were anonymous. The link to the survey was sent along with information to respondents' pack that clearly detailed the aims of study and a letter of encouragement to respondents in the survey. The letter was endorsed by a researcher. Survey respondents were asked to answer questions on the basis of their personal opinion and practice.

2.3. Statistical analysis

The data was obtained and compiled with descriptive statistical analysis and using Statistical Package for Social Science (IBM SPSS version 22, USA).

3. Results

A total of 104 from 116 dental professionals responded to this survey, thus making a response rate as 89.66%, which was satisfactory. Majority of the respondents was at the age range of 25-30 years old (78.85%) with 0-5 years of experience (69.23%) and almost were Oral and Maxillofacial Surgery specialist in the present survey (88.85%), the respondents' demographic and characteristic data were presented in Table 1.

The study was found that 100% of response not to use antibiotics to manage oral diseases cases of halitosis and orthodontic treatment. More than 80% of response relied on not using antibiotics in tooth fracture, dental caries with pulpitis, endodontic treatment, apical periodontitis and dry socket. While more than

Table 2. The response rate of respondents.

Question	% Answer 'YES'	% Answer 'NO'
Do you routinely prescribe antibiotics in the following situations?		
Halitosis	0.00	100
Tooth fracture	1.92	98.08
Dental caries with pulpitis	11.54	88.46
Dento-alveolar abscess	59.62	40.38
Orofacial infections with signs of systemic involvement	96.15	3.85
Pericoronal abscess	69.23	30.77
Extraction by open method	42.31	57.69
Surgical removal of impacted tooth	80.77	19.23
Flap surgery	65.38	34.62
Implant placement	63.46	36.54
Orthodontic treatment	0.00	100.00
Endodontic treatment	3.85	96.15
Localized intraoral swelling	51.92	48.08
Acute facial swelling	84.62	15.38
Periapical abscess	55.77	44.23
Apical periodontitis	13.46	86.54
Dry socket	5.77	94.23

Table 3. The response rate of respondents due to antibiotic situation.

Questions	% Answer
In case of localized infection, non-allergic patient;	
What antibiotic will be the first line to begin?	
Penicillin	96.15
Metronidazole	1.92
Cephalexin	1.92
In case of localized infection in allergic to penicillin patient, the first line is	
Clindamycin	100
In which cardiac case, the patient will not need prophylaxis with antibiotics	
Stable angina	94.23
Congenital heart disease	3.85
Prosthetic cardiac valve	1.92

50% of response relied on not using antibiotics in extraction by open method. However, less than 50% of response relied on not using antibiotics in addition to dento-alveolar abscess, orofacial infections with signs of systemic involvement, pericoronal abscess, surgical removal of impacted tooth, flap surgery, implant placement, localized intraoral swelling, acute facial swelling and periapical abscess. The responses given by the respondents regarding antibiotic prescription for commonly encountered oral conditions and routine dental treatment are compiled and presented in Table 2.

Regarding to respondents' idea towards prescribing antibiotics in situation questions, it was found that the vast majority of respondents (96.15%) chose to prescribe Penicillin as their first-choice of antibiotic of localized infection, and all respondents chose to prescribe Clindamycin in case of Penicillin allergy. The most of response rate for the patient that not need prophylaxis with antibiotics was stable angina (94.23%). Whereas, some dental professionals chose congenital heart disease (3.85%) and prosthetic cardiac valve (1.92%). The data was presented in Table 3.

4. Discussions

The objective of this study was to investigate the antibiotic usage pattern among dental professionals. The study was found that 100% of response not to use antibiotics to manage oral diseases cases of halitosis and orthodontic treatment. And the more than 80% of dental professionals in this study relied on using antibiotics in addition to the endodontic treatment. This finding showed the same specific learning of antibiotic usage from AAE Guidance on the Use of Systemic Antibiotics in Endodontics by American association of endodontists (AAE) [8], but not using antibiotics in

simple tooth fracture, dental caries, apical periodontitis and dry socket. According to a systematic review, usage of antibiotics to prevent above oral diseases was not warranted. Systemic antibiotics should be considered if there is a spreading infection that signals failure of local host responses in abating the advancing bacterial irritants, or if the patients' medical history includes the condition or diseases known to reduce the host defense mechanism or expose the patient to high systemic risk [10].

While the usage of antibiotic in other patterns, the results was shown obscure in dental and oral abscess condition. There was the study found that dental abscess (pericoronal abscess, dento-alveolar abscess and periapical abscess) and its complications position cases with early diagnosis and appropriate intervention was extremely important. The study said that determination of various host and environmental factors that put an individual at risk for development of dental abscess, influence the spread of infection from a localized collection at the apex of a tooth to a cellulitis and further life-threatening sepsis would aid treatment decisions. Increased reliance on novel molecular techniques has enriched to the knowledge of the diverse polymicrobial collection that constitutes a dental abscess [11]. But, at present, there is no consensus over the gold standard treatment as evidenced by the wide variety of surgical protocols and prescription of antibiotic in dental abscess condition.

Antibiotics are increasingly used in the treatment of orofacial infections. There was the available study suggested that antibiotic prescribing should be considered only after the conventional therapies have not been successful and used follow the guideline [12].

Additionally, there was limitation of scientific evidence for treatment and prophylactic with antibiotic prescription for dento-alveolar surgical procedures. In common as the scientific evidence, dental professionals were seen prescribing antibiotics for routine dento-alveolar surgical procedures including simple extractions, which demands attention. There was the study found that majority of the professionals felt adhering to the strict sterilized measures, in and around operative area during dental procedures were not enough to prevent infections; this might be the reason for majority of dental professionals to prescribe antibiotics [13]. However, another study found the point that there were the therapeutics recommends antibiotic prophylaxis and treatment for surgical procedures with a high infection rate and/or implantation of prosthetic devices. Applying this to the field of dentistry, antibiotic can be also recommended to the placement of dental implants. However, there are reports of the effects of antibiotic used in dental implant that there was no statistically significant difference between used and not used antibiotic in healthy patient [14]. Therefore, dentist should consider reasonably in antibiotic usage to reduce the developing bacterial resistance [15].

Furthermore, in case of local infection and antibiotic usage of choice, this study found the same as many literatures, that the dental professionals used Penicillin as the first line drug. Although Penicillin has a narrow antibiotic spectrum, it covers most bacteria involved in oral infections. For patients allergic to Penicillin, it is recommended to use Clindamycin which is highly effective against Gram-positive, anaerobic, and some Gram-negative bacteria [16].

In case of the prophylaxis with antibiotics, was a common practice, and has been widely accepted in the dental professionals. In this study the majority of respondent was following the same point of the paradigm that using antibiotic to prevention of bacterial endocarditis, indicated in risk patients in the context of any invasive procedure within the oral cavity - and following the guidelines of the American Heart Association (AHA) [17]. However, in this study, some of dental professionals were potentially misconception in indication of antibiotics prophylaxis usage. The strength of this study was that it provides a better understanding of antibiotic usage pattern among certain dental professionals. It will be baseline evidence for future research which will be conducted after the implementation of the dental strategic plan on antibiotic usage. But there was the limitation as, this study recruited respondents through online and social media. Some of the potential respondents might have not participated since they are unable to access online platforms, particular the older respondents which coincides with this study which found that most of respondent were dental professionals with 0–5 years of experience (69.23%) and 25–30 years old (78.85%). Years of experience may result in a difference of antibiotic usage pattern, so it has to be further studied in a future study.

However, this study does not assess antibiotics dispensing such as appropriateness of dosage regimens and patient counseling in dental practice. This may need to be measured in future studies.

5. Conclusions

There was still an over prescription in practitioners when compared to the other studies. This may have probably been due to inadequate understanding of the disease, less skill, and less competency in performing operative intervention measures. It has to be understood that dental diseases are largely because of local factors. So, the need for prescribing antibiotics should be considerably. Antibiotics should be used only as aides even when there is a real need and never as first-line treatment modality. In conclusion, the prescribing practices of dental professional can be improved by increasing awareness and following the recommended guidelines among dental practitioners for further develop of the antibiotic usage program in the Dental hospital.

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Factors that influence auditors' going concern audit opinion in Indonesia

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Abstract

The purpose of this research is to determine the factors that influence auditors' going concern audit opinion in Indonesia, in both financial and non-financial factors. The sampling in this research was obtained using a purposive sampling method by focusing on manufacturing companies listed on the Indonesia Stock Exchange during 2014 to 2018 periods, and thus obtained 155 observations data out of 31 companies. The data analysis method used in this research was logistic regression. Based on the analysis' results, the variable of profitability ratio is negative affects the going concern audit opinion and audit opinion of the previous year is positive affects the going concern audit opinion. Meanwhile, the leverage ratio, company size, company growth, and PAF's reputation had no effect on going concern audit opinion. The implication of this research is that going concern audit opinion can contribute to the consideration of investors' decision in making investment.

Keywords: Going concern audit opinion, financial factors, non-financial factors
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1. Introduction

2019 was a bleak year for several well-known public accounting firms (PAF's) in Indonesia. Some PAF's have been sanctioned by the financial services authority for mistakes made when auditing the client's financial statements. These PAF's include Purwanto, Sungkoro, and Surja (Member of Ernst and Young Global Limited / EY), PAF's Tanubrata, Sutanto, Fahmi, Bambang & Partners (Members of BDO International), PAF's Amir Abadi Jusuf, Aryanto, Mawar & Associates (Affiliates from RSM International), PAF's Satrio, Bing, ENy & Partners (Deloitte Indonesia Partners) (Jakarta, CNBC Indonesia, Agustus 2019). Many parties feel disadvantaged over the information about the inaccurate financial statements; in this case the auditor is considered participating in providing information about the inaccurate financial statements. The American Institute of Certified Public Accountants (AICPA, 1988) has determined that auditors must state whether a company be able to continue its going concern for one year after reporting.

The auditor will examine to determine whether the financial statements fairly present all material matters in accordance with generally accepted accounting principles, objectively. The auditor will issue an audit opinion to give an opinion on the audited financial statements. To ascertain whether the company can maintain its survival, an auditor issues an opinion called going concern audit opinion (SPAP, 2011). The goal of an established business entity is to maintain the going concern of its business. Continuous significant operational losses are conditions experienced by the company that can raise doubts in giving an indication of the business continuity of a company. O'Reilly (2010) revealed that going concern audit opinion will give a negative signal to the company's survival, while non going concern audit opinion will give a positive signal as a sign that a company is in good condition, so that this audit opinion should be useful for external parties who have an interest in the company, such as an investor. The difficulties the company have in increasing loan capital, stock price setbacks, mistrust of investors, creditors, customers and employees of the company's performance; are the impact of issuing going concern audit opinion, therefore it is not expected to occur in a company.

There are several reasons for going concern audit opinion's acceptance to emerge; the first reason is an internal factor where the company's business activities experience operating losses, working capital shortages, and negative cash flow; which called as negative trend. Another internal factor is a situation where the company's operating cash flow is not sufficient to meet its current liabilities and the company is forced to take steps to improve the company; this one called financial distress. Other internal problems are labor-related

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issues such as lack of long-term commitment of employees and employee strikes. Meanwhile, the second cause is external factors or problems from outside the company related to the business entity's survival. Besides company's financial factors, an auditor also needs to consider the company's non-financial factors in giving opinion. Research conducted by Wulandari [1] analyzes the factors that influence the auditor in giving a going concern audit opinion; the results of her research prove that the previous year's audit opinion influences auditors' going concern audit opinion. While other variables such as profitability ratio, leverage ratio, PAF reputation, company size, company financial condition, activity ratio, liquidity ratio, and growth ratio have no effect on auditors in providing going concern audit opinion.

Izzati and Sularto [2] showed that simultaneously or overall, PAF size variables, previous year's audit opinion, profitability, leverage, and company growth; had a significant effect on the probability of going concern audit opinion's acceptance. Pravasanti and Indriaty's research [3] concluded that the current ratio, debt ratio and profitability (ROA) variables did not affect the going concern audit opinion. Kartika [4] found that company growth has an effect on auditors in providing going concern opinion. Alichia [5] concludes that company size has a significant effect on going concern audit opinion. Krissindiastuti and Rasmini [6] analyzed that company growth had a negative effect on going concern audit opinion, company size and previous year's audit opinion had no effect on going concern audit opinion, PAF's reputation had a positive effect on going concern audit opinion. Based on the results of previous researches, it can be seen that there are inequality of research results; there are variables that have a significant effect and do not affect the probability of going concern audit opinion's acceptance, in accordance with the data used from each researches. The importance of information about going concern audit opinion encourages researchers to re-identify factors that might influence the publication of auditors' going concern audit opinion. Based on the background that has been explained, the formulation of the problems that can be taken in this research are as follows: Do financial and non-financial factors influence the going concern audit opinion? Therefore, the purpose of this research was to determine the effect of financial and non-financial factors on going concern audit opinion.

2. Literature Review and Hypothesis Development

Agency theory and signaling theory is the grand theory in this research. ROA indicates the company's ability to use its assets to make a profit. The higher the company's ROA level, the better the company's performance in managing its assets for profit. In other words, the higher the company's ROA level, the lesser the company's probability to get an auditor's going concern opinion [2]. Therefore, the higher the company's ROA level, the more good news information is given to the investors caused by the better company's performance in the future. As a result, this will be able to convince investors to invest in the company. Kristiana [7], Noverio and Dewayanto [8], Izzati and Sularto [2] prove that the profitability ratio has a significant effect on the going concern audit opinion. H_1: Profitability ratio negative influences the auditor in providing going concern audit opinion.

The high leverage ratio identifies a company's poor financial performance, causing uncertainty about the company's viability [13]. Leverage ratio measures the level of use of debt as a source of corporate financing, companies that have greater liabilities than assets, will potentially liquidate. The higher the leverage ratio, the higher the uncertainty arises regarding the viability of a company and shows the company's poor financial performance. A low corporate leverage ratio will provide good news information to investor; it will show that the company's financial performance is getting better. The information provided by the company is a signal given to stakeholders for decision making. Rudyawan and Badera (2008), Rahman and Siregar (2013) prove that the leverage ratio has a positive influence ongoing concern audit opinion's acceptance. H_2: Leverage ratio positive influences the auditor in providing going concern audit opinion.

Kristiana [7] stated that the greater the total assets, sales and market capitalization, the greater the size of the company. McKeown et al. (1991) say that smaller companies tend to offer less high audit fees than those offered by large companies. This lead to auditor's hesitation in giving going concern audit opinion to large companies and will more often publish going concern audit opinion in smaller companies, because auditors believe that larger companies have better abilities to maintain their viability even though the company experienced financial distress. Therefore, the larger the size of the company, the less the company's probability accept going concern audit opinion; it will provide good news information for investors (Widyantari, 2011). This was also proven in research conducted by Alichia [5], Santosa and Wedari [9] that company size influences going concern opinion. H_3: Company size negative influences the auditor in providing going concern audit opinion

The higher the ratio of auditee sales growth, the less the auditors' probability publishes going concern audit opinion. Auditees have the opportunity to gain increased profits if sales continue to increase from year to year [4]. Auditees that have a positive sales growth ratio and experience growth, which shows the company's operational activities are running properly, indicate that the auditee capable of maintaining the viability of its business. Therefore, companies with positive growth gives good news information signals

to investors because they indicate a smaller trend of bankruptcy. Research by Kartika [4], Rahman and Siregar (2013), Ginting and Suryana [10] shows that company growth has a negative and significant influence on going concern audit opinion. H_4: Company growth negative influences the auditor in providing going concern audit opinion.

The possibility for the auditor to publish a going concern audit opinion in the current year will be greater if the auditee receives a previous year's going concern audit opinion, because the company will be considered to have problems in maintaining its viability (Ramadhany, 2004). Some researchers found that auditors often publish going concern audit opinion if the previous year's audit opinion is going concern audit opinion [11]. So, if in the previous year the auditor did not publish a going concern audit opinion, it would provide good news information (signals) for investors because this condition could help convince investors to invest in the company. Research conducted by Rahman and Siregar (2013), Wulandari [1] and Kartika [4] proven that the previous year's audit opinion had a significant effect on the auditor in providing going concern audit opinion. In other words, the previous year's audit opinion will be an important consideration factor for the auditor to publish a going concern audit opinion in the following year. H_5: Previous year's audit opinion positive influences the auditor in providing going concern audit opinion.

Auditors from large-scale PAF will have a good reputation, therefore the quality of the audit results will be good and will provide opinion according to the company's situation. A large-scale PAF will provide better audit quality compared to a small-scale PAF, including the provision of going concern audit opinion[12]. According to users of large-scale PAF financial statements and allianced with international PAFs, they will provide higher quality audits. This is in accordance with agency theory which states that conflicts of interest between principals and agents require the presence of an independent third party; the auditor to mediate conflict between those two parties (Rahman and Siregar, 2013). Triseptya (2014) said that large PAFs tended to be more independent in expressing and reporting fraud committed by clients. This becomes the concern of the auditor, because if the public discovers corporate fraud that is not disclosed by the auditor, it will threaten their reputation. Based on research conducted by Santosa and Wedari [9], both large and small-scale PAFs will always be objective in providing audit opinion. If the company is unable to maintain the viability of its business, the auditor will give a going concern audit opinion. Research by Ginting and Suryana [10], Ardiani et al. [12], Krissindiastuti and Rasmini [6] concluded that the PAF's reputation had a positive influence on going concern audit opinion. H_6: PAF's reputation positive influences the auditor in providing going concern audit opinion.

3. Research Method

The populations used in this research are all financial statements of manufacturing companies on the Indonesia Stock Exchange during 2014-2018. This research uses purposive sampling method to determine the number of samples used; the sampling method with certain criteria. The criteria for determining the sample are as follows: 1) the company publishes an audited financial report by an independent auditor during the 2014-2018 periods, 2) the company suffered a loss, at least once in the research period, 3) use rupiah exchange rate in financial reporting, and 4) the required data is completely available. Audit opinion is measured using dummy variables. The going concern audit opinion will be given code 1; otherwise, the non going concern audit opinion will be given code 0. Going concern audit opinion is measured using a dummy variable. Companies included ingoing concern audit opinion are given code 1; otherwise, those included in non going concern audit opinion are given code 0. Profitability is proxied by return on assets; can be calculated by comparing the ratio between profits (and loss) after tax divided by total assets. The leverage ratio is proxied by debt to equity ratio, and is measured using a ratio between total liabilities divided by total equity. The size of the company can be seen based on the total log of assets owned by the company. Company growth is measured using the percentage change in growth in total assets (total year-end assets divided by total initial-year assets). The previous year's audit opinion was measured using a dummy variable, if the company received a going concern audit opinion in the previous year it was given code 1; otherwise, if the company received a non going concern opinion in the previous year it was given code 0. PAF's reputation is measured using dummy variables. Code 1 is given for companies that use big four PAF's services or those affiliated with big four PAFs; otherwise, code 0 is given for companies that use non big four PAF's services. The method of analysis uses logistic regression; a regression used to test whether the probability of the occurrence of a dependent variable can be predicted with the independent variable. Logistic regression is used because the majority of variables are measured using a dummy variable.

4. Result and Discussion

This research was conducted on manufacturing companies listed on the Indonesia Stock Exchange and published financial reports from the 2014-2018 period in a row, data was obtained from the Indonesia Stock Exchange website (www.idx.co.id). Based on the explanation of the sampling method, the number of companies that met the criteria in this research was 31 companies with 155 observations data. The prediction magnitude of the six variables on going concern audit opinion can be seen from Nagelkerke R Square;

Table 1. Iteration history[a,b,c,d].

Iteration	-2 Log likelihood	Coefficients						
		Constant	PROFIT	LVRG	UP	PP	OPINION	PAF
Step 1 1	43,184	-3,753	-0,030	0,001	0,068	-0,008	2,922	-0,201
2	32,686	-7,997	-0,061	0,001	0,188	-0,018	3,861	-0,615
3	30,343	-12,916	-0,083	0,001	0,344	-0,027	4,406	-1,354
4	29,964	-15,700	-0,091	0,000	0,435	-0,029	4,663	-2,293
5	29,888	-16,192	-0,093	0,000	0,451	-0,029	4,706	-3,293
6	29,861	-16,205	-0,093	0,000	0,452	-0,029	4,707	-4,296
7	29,851	-16,205	-0,093	0,000	0,452	-0,029	4,707	-5,297
8	29,848	-16,205	-0,093	0,000	0,452	-0,029	4,707	-6,297
9	29,847	-16,205	-0,093	0,000	0,452	-0,029	4,707	-7,297
10	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-8,297
11	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-9,297
12	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-10,297
13	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-11,297
14	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-12,297
15	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-13,297
16	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-14,297
17	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-15,297
18	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-16,297
19	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-17,297
20	29,846	-16,205	-0,093	0,000	0,452	-0,029	4,707	-18,297

Source: Processed secondary data

Table 2. Model summary.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	29,846[a]	0,386	0,696

Source: Processed secondary data

where the value is indicating how the variability of the independent variables can explain the variability of the dependent variable.

Overall model fit was tested using the value of -2 Log likelihood or omnimbus test. The -2 Log likehood values that drops large enough, indicates that the model will be fit. Note that the value-2 Log likehood (-2LL) where at the beginning (block number = 0) the -2LL value is 75.251, but when in (block number = 1) the -2LL value drops to 29.846. This reduction in likelihood indicates a better regression model or a hypothetical model that fits the data. The evidence of a decrease in the value of -2 Log likehood whichis the test that leads to the shape of the model fit can be seen from the Chi-Square value (the decrease value of -2 Log likehood) on the Omnimbus test of model coefficients.

The prediction magnitude of the six variables on going concern audit opinion can be seen from Nagelkerke R Square; where the value is indicating how the variability of the independent variables can explain the variability of the dependent variable. The value of Nagelkerke R Square in the test can be seen in the table above. The table shows that the value of Cox and Snell R Square is 0.386 and Nagelkerke R Square is 0.696 which means 69.6% of the variability of the dependent variable can be explained by the independent variables, while the remaining 30.4% is explained by other variables beyond research.

Table 3. Variables in the equation.

Step 1	B
PROFIT	-0,093
LVRG	0,000
UP	0,452
PP	-0,029
OPINION	4,707
PAF	-18,297
Constant	-16,205

Source: Processed secondary data

The logistic regression test results generate a model below:

Table 4. Research result.

Step 1	B	Sig.
PROFIT	-0,093	0,022
LVRG	0,000	0,990
UP	0,452	0,352
PP	-0,029	0,935
OPINION	4,707	0,000
PAF	-18,297	0,999
Constant	-16,205	0,236

$$
\begin{aligned}
L_n \frac{\mathrm{GC}}{1-\mathrm{GC}} &= -16,205 - 0,093(\mathrm{PROFIT}) \\
&+ 0,000(\mathrm{LVRG}) + 0,452(\mathrm{UP}) \\
&- 0,029(\mathrm{PP}) + 4,707(\mathrm{OPINION}) \\
&- 18,297(\mathrm{PAF}) + \varepsilon
\end{aligned}
$$

4.1. The influence of profitability ratio on going concern audit opinion

Based for tabel research result shows that the profitability ratio negatively influences the auditor in providing going concern audit opinion. Besides having a significant influence, the profitability ratio variable also negatively influences the going concern audit opinion, this means that the higher the profitability (ROA) of a company, the lower the company's possibility to get going concern audit opinion. The higher the company's ROA, the better the company's performance in managing its assets to generate profits. A company with high profitability shows that the company is able to run its business well so that it can maintain its viability. This is consistent with the signal theory which states that the information provided by the company will help the stakeholders in making decisions. These results support the research of Izzati and Sularto [2] and Kristiana [7] where the profitability ratio variable significantly influences the possibility of going concern audit opinion's acceptance. However, it is not in line with Wulandari's [1] research which results that profitability ratio does not influence going concern audit opinion.

4.2. The influence of leverage ratio on going concern audit opinion

Significance value greater than 0.05 indicates that the leverage ratio does not influence auditors'going concern audit opinion by the. Leverage variable that has no effect on going concern audit opinion shows that even though the amount of the company's debt is high, as long as the company can maintain the company's performance well, yet the auditor will not give going concern audit opinion to the company. The high amount of debt must also be accompanied by efficient management of company assets so that they experience growth each year. If the company can manage assets efficiently, the sales volume can increase. If the sales volume increases, the company will have funds to pay its debts. Therefore, the auditor is unlikely to give a going concern audit opinion. The information provided by this company is a signal given to stakeholders for decision making [2]. These results support the research of Wulandari [1], Wibisono [13] and Indrianty and Cahyaningsih (2012) where the leverage ratio variable does not influence the probability of going concern audit opinion. However, it is not consistent with research conducted by Rahman and Siregar (2013) who found that leverage ratio has a positive influence on going concern audit opinion's acceptance.

4.3. The influence of company size on going concern audit opinion

This research result shows that company size has no influence on the going concern audit opinion. Company size is not a factor whether companies experiencing financial difficulties or not; small companies with low assets do not necessarily make the company receive a going concern audit opinion. No influence was found on company size on going concern audit opinion's acceptance because of the identical management ability in presenting financial statements. Companies with good management and present actual financial reports in the company, tend to receive a clean opinion from the auditor. Thus, if a small company is also able to have good management and present financial statements fairly, it will be able to get a clean opinion from the auditor. So, in giving an opinion, the auditor is not influenced by the size of the company, but still guided by the standards set (Hakim, 2017). The result supports the research of Saputra and Praptoyo [14] and Krissindiastuti and Rasmini [6] where company size does not affect the probability of going concern audit opinion's acceptance. However, it does not support the research of Alichia [5] which provides evidence that company size influences going concern audit opinion's acceptance.

4.4. The influence of company growth on going concern audit opinion

This shows that company growth does not influence the provision of going concern audit opinion. This shows that high company growth does not guarantee not receiving going concern audit opinion, and vice versa. If the company experiences a profit declination, the company will not receive going concern audit opinion as long as the company continues making profit. The company's ability to make a profit indicates that the company can run its business well. The company's assets increase, however, the company's sales remain or decrease, and the company's increasing obligations will not make the company better and reduce the probability of getting going concern audit

opinion [1]. These results support the research of Izzati and Sularto [2] and Andini and Mulya [15] where company growth has no influence on going concern audit opinion. However, this is not in line with the research of Kartika [4] and Krissindiastuti and Rasmini [6] where company growth has a significant influence on going concern audit opinion.

4.5. The influence of previous year's audit opinion on going concern audit opinion

Besides having a positively significant influence on the previous year's audit opinion, it also has a positive influence on going concern audit opinion. This shows that the previous year's audit opinion influenced the auditor's decision to republish going concern opinion by considering the previous year's going concern audit opinion the company had received. Companies that receive going concern opinion in the previous year tend to receive the identical opinion in the current year [2]. These results support the research of Andini and Mulya [15] and Kartika [4] where the previous year's audit opinion has a significant influence on the probability of going concern audit opinion's acceptance. However, this research is not in line with the research of Krissindiastuti and Rasmini [6] which state that the previous year's audit opinion has no influence on going concern audit opinion.

4.6. The influence of PAF reputation on going concern audit opinion

This explains that when the auditor carries out their duty to examine and provide opinion on financial statements, the auditor will try to maintain their reputation and will avoid things that can spoil their reputation. Therefore, the PAF's will always be objective in giving their opinion [14]. If a company experiences doubts in its business viability, going concern audit opinion will be given, regardless of whether the auditor is classified as a big four or not. The PAF's reputation will be poor if it cannot provide the proper opinion of the audited financial statements. Thus, the PAF's size does not influence the possibility of receiving a going concern audit opinion [2]. The results of this research are not in linewith the research of Ginting and Suryana [10], Ardiani et al. [12] and Krissindiastuti and Rasmini [6] which stated that PAF's reputation had a significant influence on going concern audit opinion. However, this research is in line with research conducted by Saputra and Praptoyo [14] and Verdiana and Utama (2013) who found that PAF's reputation had no influence on going concern audit opinion's acceptance.

5. Conclusion

The results of the research concluded that the previous year's profitability is negatively influenced the going concern audit opinion ratio and audit opinion is positively influenced the going concern audit opinion. However, leverage ratio, company size, company growth, and PAF's reputation have no influence on going concern audit opinion. The research that has been carried out basically has limitations and weaknesses that require improvement in the future, namely research findings that are less than perfect. Therefore, the advice need to be given for future research is to use other analytical tools, such as Structural Equation Modeling (SEM) with Warp PLS 4.0, Eviews, and others because to show different research results and use more suitable analytical tools.

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Linking corporate social responsibility, intellectual capital and corporate financial performance: Evidence from banking company in Indonesia

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Abstract

Finding empirical evidence on the role of CSR and intellectual capital to improve financial performance is the aim of this study. The banking companies listed on the Indonesian Stock Exchange (BEI) for the period 2012–2018 used as sample in this research. The information presented in the annual report is secondary data used in this study. Structural equation modeling (SEM) with Warp PLS 4.0 is a data analysis technique used. The result of research shows that CSR has positive effect on financial performance, CSR has positive effect on intellectual capital, intellectual capital has positive effect on financial performance, intellectual capital mediates positive influence of CSR on financial performance, and financial performance has positive effect on CSR. The implication of this research is to give a viewpoint to the company about the importance of CSR to create personal branding so that it will have an impact on company's financial performance.

Keywords: Corporate social responsibility, intellectual capital, and financial performance
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1. Introduction

The cases in company of Apple, Canon, Coca-Cola and Walmart [1] become an example of the lack of corporate awareness of their social responsibilities. Coca-Cola was boycotted in India because the local people were suffered from drought. Walmart was caught using child labor at factories in Bangladesh, and the suicide at the Apple factory [1]. This incident should provide a view to the company to be more responsible for social and environmental issues or often called corporate social responsibility (CSR). In other words, companies are no longer faced with responsibilities that are grounded in a single bottom line, that is, the value of a company that is reflected in its financial condition. Awareness of the importance of CSR is based on the notion that companies not only have economic and legal obligations to shareholders, but also obligations to other interested parties. CSR shows that corporate responsibility must be based on triple bottom lines, namely corporate responsibility in social, environmental and financial aspects. All CSR activities undertaken by the company are costly. This triggers the company to calculate the trade of cost and benefit, so there is an ambiguity between social motives and economic motives which will be experienced by the company. This will become the company's consideration in conducting CSR activities. Companies will allocate more resources for CSR activities if it has a positive impact to maximize profits as it will improve financial performance. However, companies will be more careful in allocating resources if negative impacts on CSR activities occur [2]. Friedman [3] stated that the investments allocated for CSR activities will reduce the opportunity to utilize resources, thus reducing maximum profitability. So this will trigger a conflict of interest [4].

However, Tu and Huang [5] have different views. Based on the perspective of stakeholder theory, the investments allocated for CSR activities can streng then the relationship of companies and stakeholders, so it can assist stakeholders in controlling their resources. This is in line with Orlitzky, et al. [6] statement, if the company's resources are used for CSR activities it will improve the company's image in the public eye, and according to Greening and Tuban [7] it can also increase employee attractiveness. So that it will increase the competitive advantage of the company [8] so that the financial performance of the company will increase ultimately [9]. The research results of related to these subject are varied. Uadiale et al. [10]; Bedi et al. [11]; Bird et al. [9] proves that CSR has a positive effect on financial performance. As well as

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Noughton et al. (2015), in his research found the evidence that the CSR which is not allocated for charity and it wasn't improving financial performance. Instead, the company has CSR expenditure in the current period to anticipate a stronger future financial performance. Nevertheless Babalola, 2012; Barnett and Solomon, [12]; Orlitzky [6] found the contrary evidence, where CSR has a negative effect on financial performance. While Surroca [13] found evidence that CSR relationships and financial performance are confusing and unidentified.

On the other hand, the research from Ramadhani and Mashariono [14] and Rambe and Wira [15] proves that financial performance has a positive effect on CSR. In the contrary, the research of Wardhani and Sugiharto [16] and Anggraini [17] gives the opposite result, which is financial performance has a negative effect on CSR. Based on the findings of the research, it can be concluded that CSR and financial performance have reciprocal relationship. To clarify the various theoretical point of view and research results, it needs additional variable [13]. This study will add intellectual capital variable as a mediator between CSR activities on financial performance. The result of this study is expected to explain the direct or indirect effect of CSR activities on financial performance. The research findings from Lin et al. [2] provides the evidence that intellectual capital mediates the influence of CSR on financial performance. Based on the argumentation and previous research results, the research questions related to CSR, intellectual capital and financial performance, are as follows: 1) does CSR has a positive effect on financial performance?, 2) does financial performance has a positive effect on CSR?, 3) does CSR has an effect positive to intellectual capital?, 4) does intellectual capital have a positive effect on financial performance?, 5) does intellectual capital mediate the positive influence of CSR on financial performance?

2. Literature Review and Hypothesis Development

The stakeholder theory is grand theory in this research. The CSR activities are conducted by the company to establish relationships with employees, surrounding communities, the environment and to improve corporate governance, so that corporate expenses will increase. As result, a shifting focuses in the company's from maximizing shareholder value on the wider interests of stakeholders. However, it will have a positive effect on the company's performance [18]. The CSR activities will contribute to the development of corporate's impression to the public so it will improve employee's productivity [7], and this is in accordance with stakeholder theory. Research conducted by Lin, et al. [2] and Bird [9] proves that CSR has a positive effect on financial performance. Based on the argumentation and the support of previous research. H_1: CSR has a positive and significant impact on financial performance.

The establishment and development of a company can not be separated from the role of stakeholders. Stakeholders will influence and be influenced by the existence of the company. In order to maintain company's existence, the company should carry out the social responsibility towards stakeholders: the employees, the surrounding community, and the surrounding environment. The achievement of good financial performance will tend to make the company more concerned and responsible to its stakeholders, because this will establish a personal branding for the company. These CSR activities will not bring disadvantage to the company, otherwise it will maintain the company's sustainability, and at the same time it becomes the company's long-term strategy. Research conducted by Ramadhani and Mashariono [14] and Rambe and Wira [15] proves that financial performance has a positive effect on CSR. H_2: Financial performance has a positive and significant effect on CSR.

Perspective of stakeholder theory states that investment in CSR activities can improve the relationship between companies and stakeholders, thus helping companies securing resources controlled by stakeholders [5]. Based on resource-based views, a valuable, scarce, in imitable, and non-replaceable corporate resources can contribute to the achievement of a company's competitive advantage [19]. If this resource is allocated for CSR activities, they will improve the company's impression and reputation in the public eye [6], increase employee appeal, increase customer confidence [7], and as a result, it increases competitive advantage [8] and improves the company's financial performance [9]. With investments related to CSR, the company will increase its intellectual capital. H_3: CSR has positive and significant effect on intellectual capital.

Intellectual capital is one of the most important intangible resources in generating value for the company [20]. Carmeli and Tishler [21] states that the value of a company is an investment function of intellectual capital. Some researchers conclude that compared to other resources, intellectual capital is one of the main sources that has a competitive advantage [22]. Tan et al. [23] found evidence that intellectual capital is positively correlated with the company's future performance, and the growth rate of the company's intellectual capital is positively related to the company's performance. H_4: Intellectual capital has a positive and significant effect on financial performance.

McWilliams and Siegel [24] explained that the relationship between CSR activities and financial performance that aims to invest, not only directly, but through mediation variables such relations it can be an indirect relationship with the concept and character of CSR. Similarly, Surroca et al. [13] stated that other variables may mediate the relationship between CSR and financial performance. Lin et al. [2] stated that

companies that invest in CSR activities will increase the intellectual capital of a company, there by it will improve the company's financial performance. The research findings by Lin et al. [2]; Surroca et al. [13] and McWilliams and Siegel [24] suggest that there are other variables that mediate the effect of CSR on financial performance. H_5: Intellectual capital mediates the positive influence of CSR on financial performance.

3. Research Method

All financial companies listed on the Indonesia Stock Exchange (BEI) during the period of 2012-2018 used as the population in this study. Sampling uses a purposive sampling method that aims to get a representative sample in accordance with specified criteria. The sample criteria. The sample criteria used are as follows: 1) banking companies listed on the IDX for the period 2012–2018, 2) the rupiah exchange rate is used in the presentation of financial statements, 3) complete data related to the variables used in the research. The reason why choosing a banking company is used as a research sample because it is based on PO OJK regulation No. 51 of 2017 banking companies in Indonesia are mandatory to make sustainable reporting.

The variables used in this research are CSR, intellectual capital and financial performance. According to Lin, et al. [2] the measurements of CSR in a various number of theoretical and empirical studies existed in many different objects. The CSR in this study measured using the total CSR costs allocated by the company in one period. The measurement of intellectual capital in this study in accordance with which developed by Pulic [31].

$$VA = OUT - IN \quad (1)$$

$$VACE = VA/CE \quad (2)$$

$$VAHC = VA/HC \quad (3)$$

$$VASC = SC/VA \quad (4)$$

$$VAIC^{TM} = VACE + VAHC + VASC \quad (5)$$

Where:
OUT = total sales and other revenue
IN = costs and expenses (besides personnel expenses)
CE = available funds (equity, net income)
HC = personnel expenses
SC = difference between VA and HC.

Such financial performance is proxied through Return on Assets (ROA). McWilliams and Siegel [24] stated that ROA and ROE is used as a basis for measuring manager's performance in decision making proccess. ROA is a reflection of the company's performance in generating profit from the resources (assets) it has. Measurement of ROA by using: net profit or loss after tax/total assets of the company. Partial Least

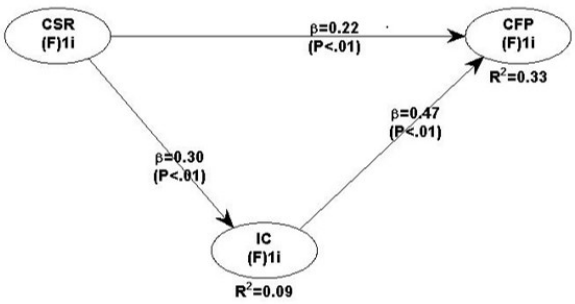

Figure 1: Indirect test results CSR, IC, and CFP.

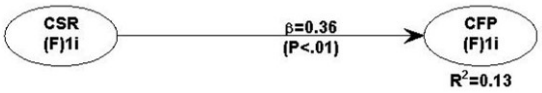

Figure 2: Direct test results CSR on CFP.

Squares-Structural Equation Modeling (SEM) analysis is used to perform path analysis (path analytic) with latent variables. PLS can be used with data collected through secondary data [25,26, 27]. The statistical analysis was chosen as it offers several advantages [28]. Path analysis is used to analyze the pattern of relationships between variables with the aim to determine the direct or indirect influence of a set of independent variables on the dependent variable. To identify the direct or indirect influence of each research variable can be explained as follows, if contribution of direct influence between CSR to financial performance is smaller than indirect influence through intellectual capital, then intellectual capital is proved as intervening variable.

4. Result and Discussion

47 banking companies were engaged in the banking industry (ICMD, 2018). Some of the companies were not chosen in the sample due to some certain criterias. The data sets employed in the main analysis consisted of the time series data of 140 annual reports from 20 banking companies during the period 2012 to 2018.

The model estimation results indicate that the criteria of goodness of fit have been met, the values of Average R-square (ARS) and Average Path Coefficient (APC) are statistically significant, and the value of Average Variance Inflation Factor (AVIF) is smaller than 5 [29]. These results are presented in the Table 1.

4.1. The influence of CSR on financial performance

Table 1 shows that the significance value <0.001 with a positive beta value 0.224 means that the first hypothesis is accepted. This means that CSR has a significant positive effect on financial performance proxyed by ROA, which means the greater the cost of CSR

Table 1. Hypothesis testing results.

Path	Direct Effect		Indirect Effect		Remark
	Coefficient	p-value	Coefficient	p-value	
CSR → CFP	0,362	<0,001***	0,224	0,001***	H_1 is accepted
CFP → CSR	0,390	<0,001***			H_2 is accepted
CSR → IC			0,298	<0,001***	H_3 is accepted
IC → CFP			0,469	<0,001***	H_4 is accepted
Model Fit Indicators					
Average Path Coefficient (APC)	0,362	<0,001***	0,330	<0,001***	
Average R-square (ARS)	0,131	0,022**	0,210	0,003***	
Average Variance Inflation Factor (AVIF)	1,000	1,095			

Source: the processing results of PLS, 2019
Note: *, **, and *** indicate significance (one-tailed) at the 0,10; 0,05; and 0,01 levels, respectively.

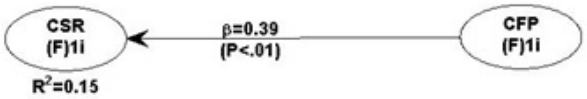

Figure 3: Direct test results CFP on CSR.

allocated by the company, the higher the ROA will increase. So it can be concluded that the cost of CSR allocated by the company will increase personal branding company which will ultimately improve the financial performance of the company. The result of this study is in accordance with the results of research conducted by Lin et al. [2] and Bird [9].

4.2. The influence of financial performance on CSR

The achievement of good financial performance will tend to make the company more concerned and responsible to its stakeholders, because this will establish a personal branding for the company. In addition, the important thing to remember is that the company can not stand alone without any stakeholder so that the existence of stakeholders will affect and influenced by the existence of the company. The CSR activities undertaken by the company aims to enhance personal branding that can also be used as a long-term strategy for the sustainability of the company. This is proved by the results of data processing which shows the significance value for financial performance variables proxyed with ROA to CSR <0.001 with a positive value beta 0.390 (see Table 1). The findings of this study are in line with research conducted by Ramadhani and Mashariono [14] and Rambe and Wira [15] proved that financial performance has a positive effect on CSR.

4.3. The influence of CSR on intellectual capital

The results presented in Table 1 and Fig. 1 shows that the value of significance for CSR variable to intellectual capital 0.001 with a positive beta value 0.298. This means that the costs allocated in relation to the CSR of the company will increase its intellectual capital. The more companies incur costs for CSR activities then the higher personal branding of the company will increase, so this will become an employee attraction that will ultimately increase the company's intellectual capital which is an intangible resource for the company. The research findings from Lin et al. [2] reinforces the findings of research by proving that CSR has a positive effect on intellectual capital.

4.4. The influence of intellectual capital on financial performance

The information presented in table 1 and figure 1 stated that the value of intellectual capital significance to financial performance proxyed by ROA shows <0,001 with beta value 0.469, this means that the fourth hypothesis is accepted. This means that the higher the company's intellectual capital, it will improve the company's financial performance. Intellectual capital is an intangible resource owned by the company, if the resources are educated, trained, and continuously improved then these resources will be better so that it can work optimally which will ultimately improve the company's performance. The findings are in line with Nuryaman [30] which proves that intellectual capital has a positive effect on corporate value and has a positive impact on its profitability so that it has a positive impact on market value and financial performance and can be used as an indicator of future financial performance. The results of this study support the research of Lin, et al. [2].

4.5. Intellectual capital mediating the influence of CSR on financial performance

The influence of CSR on financial performance can be seen directly, however, according to McWilliams and Siegel [24] and Surroca et al. [13] stated that the influence of CSR on financial performance can be mediated by other variables. The findings of this

study indicate that the significance value <0,001 and beta value indicates a positive direction 0,362 to direct effect and indirect effect show that the significance value <0,001 and beta value indicates a positive direction 0,224, means that the fifth hypothesis is accepted. This proves that intellectual capital variables proved able to mediate the influence of CSR on financial performance proxyed by ROA. The result of this study is in line with research conducted by Lin, et al. [2] which proved that intellectual capital mediates the influence of CSR on financial performance. As well as Surroca et al. [13] and McWilliams and Siegel [24] which proved that there are other variables that mediate the influence of CSR on financial performance so the relationship between CSR and financial performance becomes an indirect relationship.

4.6. Testing the significance of mediating effects

The mediating effect will be significant if three following criteria are met: 1. In the first model (Fig. 2), the path between CSR → CFP is significant 2. In the second model (Fig. 1), the path between CSR → IC is significant 3. In the second model (Fig. 1), the path between IC → CFP is significant. In the second model, the path between CSR → CFP controls the effect of IC. The effect of CSR on CFP in the second model is irrelevant for this mediation significance test. Nevertheless, if the effect of CSR on CFP in the second model is insignificant, this would indicate that the case is one of "perfect" mediation. On the other hand, if the effect of CSR on CFP in the second model is significant, this shows that the case is "partial" mediation. Generally, the weaker the effect of CSR on CFP in the second model, the more "perfect" the mediation is, providing these three criteria are met [29]. The results show that the coefficient of the direct effect of CSR on CFP in the first model (Fig. 2) is 0,362 and significant (p <0,01). In the second model, the results show that the coefficient of the indirect effect of CSR on CFP is decreased (0,224) and significant (p <0,01). Therefore, it can be concluded that IC has partially mediated the effect of CSR on CFP. This partial mediation indicate that IC is not the only mediator of the relationship between CSR and CFP.

5. Conclusion

The conclusion of this research is that CSR variable and financial performance proven to have reciprocal relationship. The CSR variable directly affects the financial performance proxyed by ROA. Similarly, when intellectual capital acts as a mediating variable or indirectly, intellectual capital mediates the influence of CSR on financial performance. The implication of this research is to give a viewpoint to the company about the importance of CSR to create personal branding so that it will have an impact on company's financial performance. While the limitations of this research is the object of research only refers to only one type of company, which is banking companies, so that the results of this study can not generalized to all types of companies listed on the Indonesia Stock Exchange. Based on limitation, the suggestion for future research is the object of the research not focusing banking companies but all types of companies, so that the results can generalized to all types of companies listed on the Indonesia Stock Exchange.

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Value added product development for oyster farmers' group in Kung Krabaen Bay Royal Development Study Center, Chanthaburi

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Abstract

This research aimed to survey consumer preference for oyster product development, developed new recipes as well as promoted oyster farmers' group in Kung Krabaen Bay Royal Development Study Center. The study asked 500 general consumers around Kung Krabaen Bay and tourists who had visited the area for feedback about oyster product. The majority of respondents preferred to Khaokriab, Numprikphao, and Todmonkrob products in 24.10, 23.40 and 18.57 frequency percentage, respectively. Three most prominent product ideas were developed in different product recipes, and tasted by 150 consumers in the study area. Each product recipe revealed that most respondents preferred Khaokriab, Numprikphao, and Todmonkrob with 10% oyster in each formula at 7.41, 6.90 and 7.43 average hedonic scale point (1-9), respectively. These confirmed a formula of each product recipe by 100 consumers in the study area. The acceptance hedonic scale point of three products: Khaokriab, Numprikphao, and Todmonkrob were 7.34, 6.70 and 6.31 average hedonic scale point (1-9), respectively. The three product prototypes were promoted to oyster farmers' group through a training process by the researcher. The training was continued until the group could reprocess products with the same quality as those made for trial. The group was preferred overall this development process at 4.61 (out of 5) average score point. Finally, the researcher assisted the farmer to apply FDA serial number for Khaokriab product until they had received the serial number.

Keywords: Oyster, oyster product development, oyster in Kung Krabaen, oyster product
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1. Introduction

Oyster is the common name for a number of different families of salt-water bivalve molluscs that live in marine or brackish habitats. In some species the valves are highly calcified, and many are somewhat irregular in shapes. Many, but not all, oysters are in the superfamily Ostreoidea. Oysters are effective filter feeders and can have large effects on the water columns in which they occur.[7] As filter feeders, oysters remove plankton and organic particles from the water column.[3] Some kinds of oysters are commonly consumed by humans, cooked or raw, and are regarded as a delicacy. Some kinds of pearl oysters are harvested for the pearl produced within the mantle. Windowpane oysters are harvested for their translucent shells, which are used to make various kinds of decorative objects. Oysters favor estuaries and embayments with low salinities and are intolerant of prolonged exposure to fresh water or marine conditions. They are found in shallow water of tidal to subtidal depth of fairly constant turbidity and salinity, but are able to withstand a wide range of temperatures. Oysters usually colonize in beds. Competition for space is an important source of mortality. Uncrowded, oysters can live to be 20 years old.[2]

However, many reports show that oysters are excellent source of zinc, iron, calcium, and selenium, as well as vitamin A and vitamin B_{12}. Oysters are low in food energy; one dozen raw oysters contains 110 kilocalories (460 kJ).[6] They are rich in protein (approximately 9 g in 100 g of Pacific oysters).[1] Traditionally, oysters are considered to be an aphrodisiac, partially because they resemble female sex organs.[10] A team of American and Italian researchers has analyzed bivalves and found they were rich in amino acids that trigger increased levels of sex hormones.[8] Their high zinc content aids the production of testosterone.[5]

The production of cultured oysters in Thailand has been approximately 2000 tons annually since 1986. Cultivation of

Crassostrea belcheri and *Saccostrea commercialis*

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were using wild seed has suffered from limitation of supply. These are mainly due to heavy exploitation of natural oyster and destruction of its habitats. Therefore, large-scale propagation of hatchery-produced seed was developed. Subsequently, the experimentation on C. *belcheri* has been carried out to support sustainable aquaculture of this species. [4]

200 members oyster farmers' group in Kung Krabaen Bay Royal Development Study Center were producing oyster in *Saccostrea commercialis* cultivar around 500 tons by natural cultivation in year 2010, and it was reduced to 100 tons since year 2015 because of the declination of visitors in tourism market. The raw oysters were sold to consumers, and faced problem in having no investment in their farm. Thus, an oyster farmers' group needed to find new opportunities to develop some good products to the market. The researcher should solve the problem of this group by using new product development method.[9][11] The type of products for development were selected by frequency percentage of consumer preferences to start making new oyster menu and recipe.

2. Material and Method

The studies were divided into 4 steps, (1) survey product ideas from consumers, (2) study composition in raw oyster, (3) develop the product and (4) promote development ideas to the oyster farmers' group in Kung Krabaen Bay area.

2.1. Consumer ideas survey

Oyster product is not widespread in the market because in past the people enjoy consuming raw oyster or cook oyster as main course menu. In order to find the suitable product from oyster, it is essential to learn what the market wants in which can lead to ideas to create new product to the market. Hence, this research started with market test with the survey on consumers' opinions in order to find product preference as well as other productions that are advantageous to the residents.

In this step, 500 local people and tourists in Kung Krabaen Bay area were collected. All of them needed to select the choice in a questionnaire regarding 1) personal detail 2) oyster product development ideas and 3) other personal opinions.

2.2. Chemical and physical composition in oyster

Composition analysis of raw oyster (*Saccostrea commercialis*) from Kung Krabean area focused on an element of moisture, fat, protein as well as ash employing AOAC method.

2.3. Oyster product development

This step can be made after the first step was completed, consumers' ideas were collected as frequency data. Then the product name was selected with the most duplicate data in order to develop prototype. The most popular three names were selected and designed recipes to develop in laboratory by making different formula, and tested step-by-step as shown below.

1. 3 types of oyster products were developed. Each product created by 5 different oyster levels with 5, 10, 15, 20 and 25% oyster in each recipe.

2. Sensory test was conducted in 9 point hedonic scale with 150 general consumers in Kung Krabaen area.

3. Selected the best sample from items with the highest average hedonic score.

4. Confirmed product recipe by reproducing the best sample version of each, and redid consumer test with 100 people in the same area.

5. Evaluated score of each recipe to confirm these product developments as fitted for market entry, suggestion average score is 6-9 points.

2.4. Promote oyster recipe to oyster farmers' group

Conducting a survey, after it could be confident that those focal formula can satisfy the market demand. The next step was to promote and to train oyster farmers'group; thus, they can provide with a standard quality. Lastly, the FDA serial number was applied.

3. Results

The results of this study comprised of 4 parts development process. The details of each part were shown as below.

3.1. Consumer detail and idea

According to a survey of 500 consumers, most respondents were 62.2% female, aged 15-25, followed by 26-35 years old. The majority had achieved a bachelor's degree (62.8%), followed by secondary school (19.4%).

The survey of consumer information related to oyster products, it was found that most consumer preferred to consume 3 products as followed: Khaokriab 24.10%, Numprikphao 23.4% and Todmonkrob 18.57%. The other inferential factors were product price, packaging and so on.

Table 1. Composition of raw oyster/100 g.

%**Moisture**	%**Fat**	%**Protein**	%**Ash**	%**Other**
73.22	19.08	6.49	1.21	0.08

Table 2. Average score of 3 oyster product samples.

%Oyster	Khoakriab	Numprik	Todmon
5	6.02[a]	6.35[a]	6.92[b]
10	7.41[c]	6.90[b]	7.43[c]
15	6.74[ab]	6.58[ab]	6.77[ab]
20	6.36[a]	6.21[a]	6.64[ab]
25	5.97[a]	6.59[ab]	6.39[a]

*Different letters in vertical means different significant ($p < 0.05$)

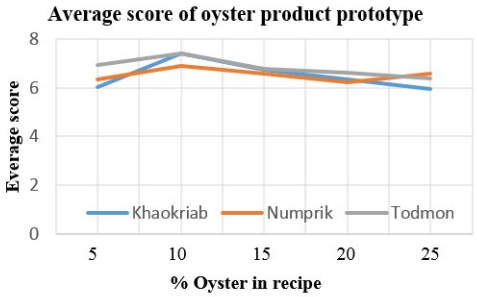

Figure 1: Trend of acceptance score with percentage of oyster in recipe.

3.2. Chemical and physical composition in oyster

The physical and chemical composition test of raw oyster (Saccostrea commercialis) revealed that moisture content was 73.22%, total fat was 19.00%, total protein was 6.49%, ash was 1.21% and other was 0.08% (Table 1)

3.3. Product development and prototype

1. Selected the best formula

The name of product from questionnaire was selected. Then, different level oyster ingredient were created at 5, 10, 15, 20 and 25% in recipe. The results of consumer test showed that Khaokriab, Numprikphao and Todmonkrob were the most preferred with 10% oyster in recipe at 7.41, 6.90 and 7.43 average score respectively (Table 2).

Trend of acceptance score showed that when oyster percentage was 5%, the score was low. When the recipe has more percentage oyster at 10%, the score was higher. When oyster percentage was higher than 10%, the score was lower (Fig. 1). The prototype products as Fig. 2.

2. Confirmation product prototype

After consumers' test in first step, the sample from most accepted score was reproduced with the same recipe again. The 3 prototype samples were re-tasted with respondents in the study area. For confirmation recipe 100 people tested different attributes of each prototype. Acceptance test was used for scoring points hedonic scale (9), in Central Location Test (CLT) method.

Figure 2: Oyster product prototype.

There were 54% female consumers and 46% were male consumers. The age of sample consumers ranged between 15 - 25 years old (57%) and 26-35 years old (28%). The majority of the consumers was under-graduated 61%, followed by diploma or under diploma 20%.

2.1) Khaokriab product confirmation

Khaokriab oyster product was taste for 4 attributes and overall acceptances. An average score from 100 people indicated that the appearance, smell, taste, texture and overall acceptance were 7.30, 6.76, 6.93, 6.27 and 6.70 score point, respectively (Table 3). The meanings of score were like, slightly-like, and very much

2.2) Numprikphao product confirmation

Numprikphao oyster product was tasted for 4 attributes and overall acceptance. An average score of 100 people unveiled that the appearance, smell, taste, texture and overall acceptance were 6.98, 6.97, 7.09, 6.93 and 7.34 score point, respectively (Table 3). The meanings of score were like, moderate-like, and very much.

2.3) Todmonkrob product confirmation

Todmonkrob oyster product was sensory 4 attributes and overall acceptance. An average score of 100 people revealed that the appearance, smell, taste, texture and overall acceptance were 7.58, 6.50, 6.00, 6.75 and 6.31 score point, respectively (Table 3). The meanings of score were like, slightly like, and very much.

3.4. Promote product prototype to oyster farmer group

After the development of all three oyster products, the results from the experiment were transferred to the oyster farmers' group. There were 15 participants, mostly aged between 45-55 years old, followed by 35-44 years old. Their educational levels were secondary and primary school. All participants had farming background, all of them were members of oyster farmers' group.

Activities included the training and demonstration. The average satisfaction was 4.61 points (from 5) or 92.20%, which means satisfaction was at the highest level. The participants who received knowledge and experience from the training satisfaction level was 4.87 points or 97.40%. The topic provided knowledge related to career satisfaction score was 4.87, or

Table 3. Average acceptance score.

Product sample	Average acceptance score				
	Appearance	**Smell**	**Taste**	**Texture**	**Overall**
Khaokriab	7.30	6.76	6.93	6.27	6.70
Numprikphao	6.98	6.97	7.09	6.93	7.34
Todmonkrob	7.58	6.50	6.00	6.75	6.31

97.40%. It was suggested by the participants that the training should be provided to villagers outside the project area in order to increase their options for processing oyster products. The facilitator will employ this suggestion to provide further trainings and academic services to the society at the next opportunity.

Moreover, researcher would help the group as a mentor to apply the good manufacturing practice standard (GMP), until passed the factory. Finally, a product Khaokriab received FDA approved with food serial number 22-2-00955-2-0001.

4. Conclusion

The results of the 3 oyster products development were shown as follows by the oyster content of product. All product would not contain more than 10% oyster in all ingredients, because consumers would not accept that. This may be due to the strong smell of oysters if the oyster mixed is too high. The color of the product is much darker, mixing of meat decreases welling. This study confirmed all three products have consistent results only with 10% oyster.

Assess the marketing potential to consumers by using the product teste results. It was found that consumers accept product prototype at like, slightly-like, and very much. This means that these three products can enter local market as well.

This research goals were to create new oyster product in order to add more choices for oyster farmers' group, to support the prices of fresh oysters as well as to create jobs and incomes for the community in the future.

Acknowledgments

Thank you to the oyster farmers' group in Kung Krabaen Bay area who presented their problems in which inspired a researcher to develop research relevant to the needs of a community. Besides, the community can also use this research to develop their occupation and career streams of income.

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The ability of various yeast strains to ferment alcohol from waste rambutan (*Nephelium lappaceum Linn*) fruit

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Abstract

Alcohol is the raw material used in the manufacture of vinegar, it can be distilled to make liquor, and refined alcohol can be used to produce ethanol as an energy source. Raw materials containing sugar, fermented with yeast, are the source of alcohol. Rambutans are fruits containing high content of sugar. After harvesting, the outside appearance of rambutans is no longer acceptable by customers because the fruit deteriorates rapidly within three to five days, resulting in decreasing value. In this research, we aimed to investigate the use of low-quality rambutans for fermentation to produce alcohol. Four single strain, two mix strains, and three combination strains of yeast (*Saccharomyces cerevisiae*) were used in alcohol fermentation of low-quality rambutans. The alcohol content was evaluated every day for 14 days after fermentation. The results showed that for the single strain of *S. cerevisiae*, the TISTR 5020 could produce the highest number of alcohol content at 11.4% after fermented 11 days, followed by the TISTR 5596 strain, which gave 10.8% alcohol on day 8. For the two mix strains of yeast, the combination between TISTR 5596 and TISTR 5194 as well as the combination between TISTR 5094 and TISTR 5596 could provide the best result at 10.5% alcohol on day 9 and day 11 respectively. In the three combinations of *S. cerevisiae*, the combination of TISTR 5596, TISTR 5194 and TISTR 5094 could produce 11.0% alcohol after fermented for 14 days while the mixture of TISTR 5094, TISTR 5020 and could provide 10.8% alcohol on day 4.

Keywords: Rambutan, ethanol product fermentation, waste rambutan, alcohol fermentation, rambutan alcohol
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1. Introduction

Fermentation is a metabolic process that produces chemical changes in organic substrates through the action of enzymes [5]. The science of fermentation is known as zymology. In microorganisms, fermentation is the primary means of producing ATP by the degradation of organic nutrients anaerobically [7]. Humans have used fermentation to produce foodstuffs, beverages and industrial production of ethanol by fermentation and distillation [2, 13].

Alcohol fermentation, also known as ethanol fermentation, is the anaerobic pathway carried out by yeasts in which simple sugars are converted to ethanol and carbon dioxide. Yeasts typically function under aerobic conditions, or in the presence of oxygen, but are also capable of functioning under anaerobic conditions, or in the absence of oxygen. When no oxygen is readily available, alcohol fermentation occurs in the cytosol of yeast cells [11]. The basic equation for alcohol fermentation shows that yeast starts with glucose, a type of sugar, and finishes with carbon dioxide and ethanol. One glucose molecule is converted into two ethanol molecules and two carbon dioxide molecules [14, 15].

Since thousands of years ago, yeasts such as *S. cerevisiae* have been used in alcohol production especially in the brewery and wine industries. It keeps the distillation cost low as it gives a high ethanol yield, a high productivity and can withstand high ethanol concentration [8]. Nowadays, yeasts are used to generate fuel ethanol from renewable energy sources [9]. Certain yeast strains such as *Pichia stipitis* (NRRL-Y-7124), *S. cerevisiae* (RL-11) and *Kluyveromyces fagilis* (Kf1) were reported as good ethanol producers from different types of sugars [12]. Yeasts can directly ferment simple sugars into ethanol while other types of feedstocks must be converted to fermentable sugars before it can be fermented to ethanol. The common processes involve in ethanol production are pretreatment, hydrolysis and fermentation. The production of ethanol during fermentation depends on several factors such as temperature, sugar concentration, pH, fermentation

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time, agitation rate, and inoculum size. The efficiency and productivity of ethanol can be enhanced by immobilizing the yeast cells.

S. cerevisiae is the most commonly employed yeast in an industrial ethanol production as it tolerates a wide range of pH [10], thus making the process less susceptible to infection. Baker's yeast was traditionally used as a starter culture in ethanol production due to its low cost and easy availability. However, baker's yeast and other *S. cerevisiae* strains were unable to compete with wild-type yeast which caused contamination during the industrial processes. Stressful conditions like an increase in ethanol concentration, temperature, osmotic stress and bacterial contamination are the reasons why the yeast cannot survive during the fermentation [1]. Flocculent yeasts were also used during biological fermentation for ethanol production as it facilitates downstream processing, allows operation at high cell density and gives higher overall productivity [4, 6]. It reduces the cost of cells recovery as it separates easily from the fermentation medium without centrifugation [3]. There are common challenges to yeasts during sugar fermentation which are rising in temperature (35–45 °C) and ethanol concentration (over 20%) [16]. Yeasts growth rate and metabolism increase as the temperature increases until it reaches the optimum value. An increase in ethanol concentration during fermentation can cause inhibition to microorganism growth and viability. Inability of *S. cerevisiae* to grow in media containing high level of alcohol leads to the inhibition of ethanol production.

Rambutan is a tropical fruit native to Indonesia and Malaysia. It grows well in a warm and humid condition. In Thailand, it is planted in the Eastern and Southern parts of the country. There are only three varieties that are popular; Rongrian, Pink and Gold verities. Currently, rambutan production is on the downward trend. Most of them are consumed in the country and neighboring countries along the border accounted for 98.50%. Over the past years, rambutan has been experiencing the problem of price decay nearly every year due to rambutan production of more than 50% come out in the middle of the production season.As a result, price often falls down in May-August. Nonetheless, there is still no solution to solve the problem of rambutan production. Some farmers cut off rambutans tree to grow other crops. This study is interested in bringing rambutan to ferment alcohol in order to use in the future, because rambutan has a natural sugar content up to 18-20%. This sugar can be the good nutrition for fermented yeast.

2. Material and Method

The studies employed unconsumed rambutan quality in Rongrain variety; fermented with 4 yeast strains in 14 days and evaluated alcohol content in percent (w/v)

2.1. Yeast strains for fermentation

Yeast for fermentation design to 3 conditions 10 treatments

1. Single strain as:
   S.cerevisiae TISTR 5194
   S.cerevisiae TISTR 5094
   S.cerevisiae TISTR 5596
   S.cerevisiae TISTR 5020

2. Mixed 2 strains as:
   S.cerevisiae TISTR 5596+TISTR 5194
   S.cerevisiae TISTR 5094+TISTR 5020
   S.cerevisiae TISTR 5094+TISTR 5596

3. Mixed 3 strains as:
   S.cerevisiae TISTR 5094+TISTR 5020+TISTR 5194
   S.cerevisiae TISTR 5020+TISTR 5194+TISTR 5596
   S.cerevisiae TISTR 5596+TISTR 5194+TISTR 5094

2.2. Rambutan preparation

A low quality rambutan was used; peeled and removed seeds. Then, it was crushing and grinding, the natural sweetness of rambutan is around 18%. The pH was also adjust to 4.0 by citric acid, and split the rambutan into 10 treatments.

2.3. Starter preparation

The 4 yeast strains were from National Center for Genetic Engineering and Biotechnology. Those strains were dried yeast, and prepared by growing them in YPD broth 48 hours, then used 5 ml of broth to rambutan juice 100 ml to make a starter. Each starter used for fermentation 5% of juice sample.

2.4. Fermentation method

Each treatment added 5% starter and fermented under anaerobic condition, then evaluated alcohol content by Ebulliometer every day until 14 days.

3. Results

The results of the study unveiled 3 parts of alcohol content from 3 groups of yeast strains. The detail of each result showed as below:

3.1. Alcohol content from single yeast

Table 1 showed that daily alcohol content was likely to increase every day (Fig. 1), which was correlated with the amount of total dissolved solids decreasing from the first day. When brix decreases, more alcohol is produced. The highest alcohol content was TISTR 5020 at 11.4% alcohol (W/V) on day 11, followed by TISTR 5596 at 10.8% alcohol (W/V) on day 8 ($p < 0.05$). Trends of alcohol are slightly increased with time.

Table 1. Alcohol Percentrate (w/v) from Single yeast strain.

Single Srain	Fermentation Day													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	3.1^{b}	6.9^{b}	8.5^{b}	9.0^{bc}	9.0^{bc}	9.0^{b}	9.0^{b}	9.3^{a}	9.4^{b}	9.3^{a}	9.4^{a}	9.2^{a}	9.0^{a}	9.0^{a}
2	4.1^{c}	9.3^{c}	8.7^{bc}	8.7^{b}	8.7^{b}	8.8^{b}	9.3^{b}	9.0^{a}	8.7^{a}	9.0^{a}	9.4^{a}	9.3^{a}	8.7^{a}	9.0^{a}
3	4.6^{c}	9.0^{c}	9.4^{c}	9.6^{c}	9.6^{c}	9.3^{b}	10.5^{c}	10.8^{b}	10.5^{c}	10.6^{b}	10.2^{b}	10.2^{b}	10.4^{b}	10.2^{b}
4	2.5^{a}	4.6^{a}	4.6^{a}	4.1^{a}	4.3^{a}	4.3^{a}	4.3^{a}	10.8^{b}	10.8^{c}	10.5^{b}	11.4^{c}	10.6^{b}	10.5^{b}	10.8^{b}

*Different letters in vertical means different significant ($p < 0.05$)

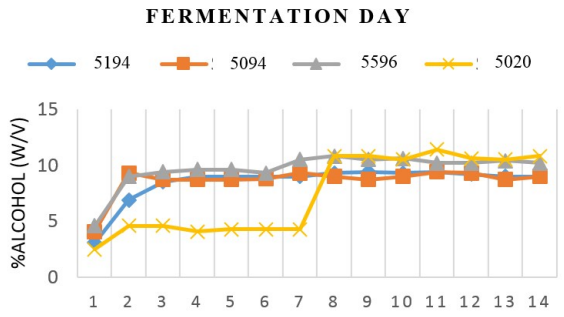

Figure 1: The percentage of alcohol (%W/V) from single yeast strain.

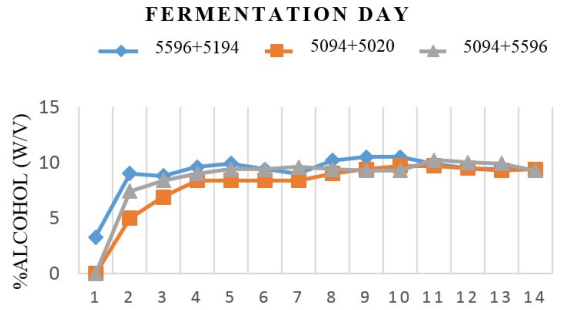

Figure 2: The percentage of alcohol (%W/V) from mixed 2 yeast strains.

3.2. Alcohol content from mixed 2 yeast strains

Daily alcohol intake was likely to increase every day (Fig. 2), which was correlated with the amount of total dissolved solids decreasing from the first day. When brix decreases, more alcohol is produced. For the use of two yeasts, the highest alcohol contents were yeast TISTR5596 + TISTR 5194 at 10.5% alcohol (W/V) on day 9, followed by TISTR 5094 + TISTR 5596 at 10.2% alcohol (W/V) on day 11 ($p < 0.05$). Trends of alcohol are slightly increased with time.

3.3. Alcohol content from mixed 3 yeast strains

Mixed 3 yeast strains, daily alcohol intake was likely to increase day by day (Fig. 3), which was correlated with the amount of total dissolved solids decreasing. When brix decreases, more alcohol is produced. The highest alcohol contents were TISTR 5596 + TISTR 5194 + TISTR 5094 at 11% alcohol (W/V) on day 14 followed by TISTR 5094 + TISTR 5020 + TISTR 5194 at alcohol content of 10.8. %(W/V) on day 4 ($p < 0.05$). Trends of alcohol are slightly increased with time as other yeast.

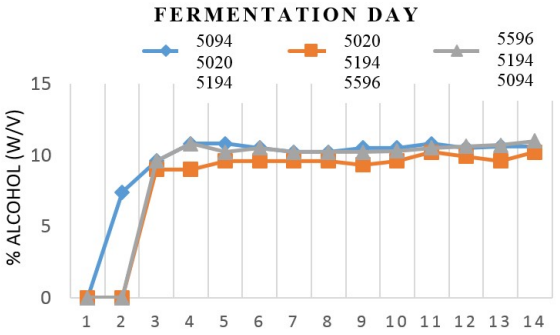

Figure 3: The percentage of alcohol (%W/V) from mixed 3 yeast strains.

4. Conclusion

All strains of *Saccharomyces cerevisiae* were significantly different in alcohol fermentation. Hence, in the future for simplicity of yeast preparation, TISTR 5020 can be used as a starter for fermentation because alcohol percentage is higher than other strains in a same fermentation day.

Low quality rambutans with 18-20% content of sugar could provide the best result of alcohol production at 11.4% on day 11 after fermentation from *S. cerevisiae* TISTR 5020. Our finding suggested that when the price of the rambutan is decreased from the market owing to its low quality after harvesting, it can be used as a source of alcohol production to produce vinegar, liquor or ethanol in the future.

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