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Development of Watermelon *(Citrullus lanatus)* Rind Spaghetti with Agar Agar – A Preliminary Study

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Abstract

The present study reports on the preparation of sweet and savory spaghetti by using an otherwise fruit waste namely watermelon rind along with agar. The sensory evaluation was carried out by 50 panelists using a hedonic scale. Panelists' response was towards liking spaghetti. Although higher scores for all attributes were observed for savory spaghetti than sweet spaghetti, no statistical significant difference was observed between two types of spaghetti for all attributes. Nutritional composition suggested a low energy product. Thus, the results of present indicate a novel way of using fruit waste into a popular product that is low energy and confers health benefits along being highly acceptable.

Keywords: Watermelon Rind, Spaghetti, Agar-Agar, Watermelon Rind Spaghetti

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1. Introduction

Watermelon belongs to the family *(Citrullus lanatus)*. It consists of three main components which are the flesh, seed, and rinds. The juice or pulp from watermelon is considered as the edible portion but rind and seeds are discarded as major solid wastes. [1].

However, the rind has been used in many ways. Value added preserved products like pickles, angelica, vadiyams and cheese were prepared using the white portion of watermelon rind with high sensory scores for the attributes. [2]. Home gardeners and small industries make rind pickles from the leftover watermelon crop, especially from cultivars having thick and crisp rind. [3]. Thai people commonly use watermelon peel as a vegetable ingredient in their curry dishes (watermelon rind sour curry) [4].

The watermelon rind flour has high functional properties and thus can be used for food formulations. [5]. Thus various researchers have incorporated watermelon rind in different products. Rind and seeds were successfully incorporated in jam and protein bars without affecting the sensory or nutritional quality of the finished product [1]. Watermelon rind flour dried using freeze drying method improved the nutritional quality and texture properties of steamed cupcakes [6]. It was demonstrated that watermelon rind flour at 10% level could be incorporated in plain cakes. [7]. Another study indicated that substitution of 5% flour and 10% fat with watermelon rinds produced acceptable cakes which were not significantly different with the control. [8]. Incorporation of water melon rind powder up to 20% in the cookie increased dietary fiber, decrease in predicted glycemic index to medium (for WRP) and improving the antioxidant activity. These changes still produce an acceptable cookie. [9].

Although watermelon rind has been utilized in many ways it was deemed worthwhile to use watermelon rind in preparation of spaghetti. Spaghetti is a, long, cordlike form of pasta made from durum wheat which is gaining popularity as a food rich in complex carbohydrates which produce slow glycaemic and postprandial insulinaemic response. [10]

2. Materials and Experiment

2.1 Population Characteristics

Watermelon was purchased from local market situated in Goregaon (West), a Mumbai suburb. The red pulp of watermelon was removed and weight of rind pieces (green and white portion) was taken. The rind pieces were then chopped to cubes. The rind cubes were ground to fine puree in a stainless steel blender. Two variations in flavor were performed – sweet and savory.

For sweet spaghetti and savory spaghetti: The proportions are as follows:

1. Sweet Spaghetti:

   For 350 gm of Watermelon rind puree

   Agar Agar : 10 gm

   Granulated Sugar : 5 gm

2. Savory Spaghetti:

Watermelon rind puree: 300 gm

Coriander leaves: 05 gm

Garlic: 05 gm

Agar Agar : 10 gm

Salt: 2gm

The contents were boiled. On boiling the gas was switched off and contents were stirred until warm. The mixture was then filled in an injection syringe and injected in plastic pipe. The dimensions of the pipe were - ½ meters in length & 8 mm diameter. Piping was done on a plate and plate was kept in refrigerator for 20 minutes for setting. After 20 minutes Pipe was removed from the refrigerator and with the help of injection syringe it was blown to remove watermelon rind spaghetti on a plate. After piping it out, Spaghetti was then kept in the refrigerator for a minimum period of 30 minutes or more.

Sensory Evaluation: Sensory evaluation of prepared spaghetti was carried out by fifty students belonging to the Department of Hotel Management of Patkar-Varde College. Nine point hedonic scale waqs used for sensory evaluation [11]. The evaluation was carried out for the following attributes - Color, Taste, Texture, Appearance and Overall Acceptability. [12].

Nutritional Evaluation: The sweet and savory spaghetti was analyzed for following nutrients – Moisture, Total Ash, Proteins, Crude Fat, [13] Sodium, Potassium, by flame photometry, Calcium [14] and Iron [15]. Carbohydrates were calculated by difference and energy was computed from the values obtained for carbohydrates, proteins and fats.

Statistical Analysis: The data on sensory evaluation was coded and analysis was carried out using SPSS version 25. Frequency distribution for all sensory attributes was performed. Chi square tests were done to see whether there was significant difference between the two types of spaghetti for all attributes. p value < or = to was considered significant

3. Results and Discussion

The results of our preliminary study are encouraging. We were able to prepare spaghetti using supposed to be the waste of watermelon that is, watermelon rind and setting with agar agar. The prepared spaghetti is shown in following photograph. (Figure 1 and Figure 2) It could also be rolled around the fork like usual spaghetti for consumption. (Figure 3).

You present the measurements made in the experiment and you then compare your measurements to the calculations you made in your preliminary work or the published theoretical values.

Figure 1 Sweet Spaghetti

Figure 2 Savory Spaghetti

Figure 3 Rolled Spaghetti on Fork

Figure 4 Use of Watermelon Rind Spaghetti

This spaghetti can be consumed as such or can be a topping for pastry. (Figure 4)

The setting and formation of spaghetti can be attributed to agar and fiber present in the rind. Agar is a hydrophilic colloid soluble in boiling water. When it is cooled it forms a firm gel that does not melt again below 85°C. [16]. Watermelon had 17.28% of wet basis. [17]. our study indicates the crude fiber content to be 0.47 gm % in sweet spaghetti and 0.25% in savory spaghetti. It has been reported that water melon rind powder consists of soluble and insoluble fibers. Normally, soluble fibers can absorb water easily, resulting in the promotion of moisture retention capacity in the cookie samples containing watermelon rind powder. [9]. Hence along with agar watermelon rind also contributed to water holding in spaghetti.

The sensory evaluation of two varieties of spaghetti was performed. The following attributes were considered for sensory evaluation - Color, Taste, Texture, Appearance and Overall Acceptability. The responses of subjects for various attributes are given below.

Table 1 Distribution of Subjects for Color of Spaghetti

9 Point Hedonic Scale	Sweet Spaghetti (%)	Savory Spaghetti (%)
Dislike extremely	0	0
Dislike very much	0	0
Dislike moderately	0	0
Dislike slightly	02	0
Neither like or dislike	02	0
Like slightly	12	06
Like moderately	28	18
Like very much	32	36
Like extremely	24	40

* N.S. The results indicate that highest percent that is 32% of panelists liked very much the color of sweet spaghetti while 40% of panelists liked the color of savory spaghetti extremely. Further, Chi Square test was carried out to see if the two types of spaghetti that were developed differed significantly in preference by panelists. The results indicated no significant difference was found in preference for this to type of spaghetti. ($\lambda = 6.205$, $p = 0.287$).

Both the varieties of spaghetti were evaluated for taste. Results are presented in Table 2.

Table 2 Distribution of Subjects for Taste of Spaghetti

9 Point Hedonic Scale	Sweet Spaghetti (%)	Savory Spaghetti (%)
Dislike extremely	0	0
Dislike very much	2	0
Dislike moderately	0	0
Dislike slightly	4	0
Neither like or dislike	10	0
Like slightly	12	6
Like moderately	26	18
Like very much	34	36
Like extremely	12	40

* N.S. The results for evaluation for taste of spaghetti indicate that 40% panelists liked savory spaghetti extremely whereas 34% panelists liked sweet spaghetti. Further, Chi Square test was carried out to see if the two types of spaghetti that were developed differed significantly in preference by panelists. The results indicated no significant difference was found in preference for this to type of spaghetti. (λ = 10.280, p = 0.147).

The preparations were evaluated for texture of the products. The results of the evaluation are presented in Table 3.

Table 3 Distribution of Subjects for Texture of Spaghetti

9 Point Hedonic Scale	Sweet Spaghetti (%)	Savory Spaghetti (%)
Dislike extremely	0	0
Dislike very much	2	0
Dislike moderately	0	0
Dislike slightly	4	0
Neither like or dislike	10	0
Like slightly	12	6
Like moderately	26	18
Like very much	34	36
Like extremely	12	40

* N.S. The results presented in table 3 indicate that highest percent of panelists that is 34% liked the texture of sweet spaghetti whereas 40% of panelists liked extremely the texture of savory spaghetti. Chi Square test was carried out to see if the two types of spaghetti that were developed differed significantly in preference by panelists. The results indicated no significant difference was found in preference for this to type of spaghetti. (λ = 3.166, p = 0.674).

Table 4 gives the data for appearance of the spaghetti.

Table 4 Distribution of Subjects for Appearance of Spaghetti

9 Point Hedonic Scale	Sweet Spaghetti (%)	Savory Spaghetti (%)
Dislike extremely	2	0
Dislike very much	2	0
Dislike moderately	0	0
Dislike slightly	0	2
Neither like or dislike	8	6
Like slightly	14	16
Like moderately	18	34
Like very much	40	30
Like extremely	16	12

* N.S. As indicated in Table 4, 40% of panelists that is the highest percent liked the appearance sweet spaghetti very much whereas 30% panelists were of the opinion that they liked spaghetti very much. Chi Square test was carried out to see if the two types of spaghetti that were developed differed significantly in response for appearance by panelists. The results indicated no significant difference was found in preference for this to type of spaghetti. (λ =6.671, p = 0.464).

Overall acceptability of spaghetti was also evaluated. The results are presented in Table 5.

Table 5 Distribution of Subjects for Overall Acceptability of Spaghetti

9 Point Hedonic Scale	Sweet Spaghetti (%)	Savory Spaghetti (%)
Dislike extremely	2	2
Dislike very much	2	2
Dislike moderately	0	6
Dislike slightly	0	2
Neither like or dislike	8	2
Like slightly	14	8
Like moderately	18	22
Like very much	40	34
Like extremely	16	22

* N.S. The results suggest that 56% of panelists either liked sweet spaghetti very much or extremely and 66% panelists reported that they liked savory spaghetti very much and extremely. Chi Square test was carried out to see if the two types of spaghetti that were developed differed significantly in preference by panelists. The results indicated no significant difference was found in preference for these two types of spaghetti. (λ =6.444, p = 0.598).

Our study has demonstrated that the spaghetti that was developed using watermelon rind was well accepted. The ratings on Hedonic scale indicate that for all attributes the preference was very high compared to non preference. Both the types of spaghetti were liked by the panelists, savory spaghetti acquiring more preference than sweet variety. Thus these findings suggest a very effective use of spaghetti that was well accepted which otherwise is a waste.

The nutrient analysis was performed for both varieties of spaghetti. The results are presented in Table 6.

Table 6 Nutrient Composition of Sweet and Savory Spaghetti

Nutrients / 100 gm	Sweet Spaghetti	Savory Spaghetti
Moisture (gm)	87.85	92.10
Protein (gm)	1.19	1.44
Fat (gm)	0.02	0.02
Carbohydrates (gm)	10.02	4.22
Energy (Kj) / (Kcal)	42 / 45	18 / 23
Calcium (mg)	46	44
Iron (mg)	0.86	0.54
Sodium (mg)	4.0	35.32
Potassium (mg)	11.2	12.5

It can be said that both the products provide less energy. The differences in energy content in both types of spaghetti can be due to the other ingredients added to it. The higher energy content of sweet spaghetti is due to addition of sugar, similarly sodium content of savory spaghetti is high due to added salt to it. The fat content was comparable, suggesting it to be a low fat preparation. Thus our recipe can be a good option to weight conscious people as well as for people on reducing diet. The novelty of recipe makes it an attractive option for young children, adolescents and young adults. The preparation can be consumed as it is or in combination, sweet type can be used in combination with variety of desserts and savory variety can be combined with variety of other ingredients.

Besides, rind spaghetti becoming a preferable option due to low energy content, rind also has phytochemicals that have now shown to confer various physiological benefits.

Various polysaccharides, predominant being galactose, followed by arabinose, glucose, galactouronic acid rhamnose, mannose, xylose present in it had a protection effect against hydroxyl radical-induced DNA damage [17]. It also contains β – carotene (96.44 %) and rinds showed significantly greater free radical scavenging capacity (39.7%) as DPPH% compared to sharlyn melon peels. [8].

Watermelon rinds also contained different types of phenolic compounds; the most abundant one was 4 hydroxybenzoic acid and vanillin (851.8 µg /g dry weight). Phenolic acids, have anti-carcinogenic and anti-mutagenic effects since they act as protective agents of DNA against free radicals, by inactivating carcinogens, inhibiting enzymes involved in pro-carcinogen activation and by activating of xenobiotics detoxification enzymes. [18].

Watermelon rind contains citrulline, a non-essential amino acid, [19]. Supplementation with L-citrulline has shown promise as a blood pressure lowering intervention (both resting and stress-induced) in adults with pre-/hypertension, with pre-clinical (animal) evidence for atherogenic-endothelial protection. Preliminary evidence is also available for L-citrulline-induced benefits to muscle and metabolic health (via vascular and non-vascular pathways) in susceptible/older populations. [20].

In conclusion, our preliminary study has suggested a novel way of using watermelon rinds to a consumer accepted product. Thus, this study has used an otherwise waste product in producing an acceptable product that not only add variety but also confers health benefits to the consumers as well.

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