Development and Sensory Acceptability of Banana Peel Flour and Balloon Vine *(Cardiospermumhalicacabum)* Incorporated Noodles

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Abstract: ***The study aimed to formulate noodles by the utilization of food by-product (banana peel flour) and enhancing the nutritional quality of noodles by incorporation of balloon vine thus making it healthier for consumption. About 38% of food wastes occur during food processing. The potentially valuable components are present in food wastes orfood by-products, such as polysaccharides, proteins, fats, fiber, flavor compounds, phytochemicals and bioactive compounds, which is beneficial to health. Experimental noodles were developed with the incorporation of unripe banana peel flour and balloon vine in the (%) ratio 10:10 (V1), 15:10 (V2) and 20:10 (V3) in wheat flour. Pure wheat flour noodles were taken as control. The sensory analysis showed that the experimental noodles V1 was most acceptable than the other variations. The functional properties (Bulk density, water absorption, oil absorption, swelling power) for Control Noodles were found to be 0.66 (g/cm^3), 4.68 (ml/g), 1.12 (ml/g), 1.46 (ml/g) respectively and for Experimental Noodles (V1) were found to be 0.65 (g/cm^3), 4.34 (ml/g), 1.5 (ml/g), 2.06 (ml/g) respectively. The proximate analysis (moisture %, ash %, protein g/100g, fat %, fibre %, iron mg/100g, calcium mg/100g and potassium mg/100g) for the Control Noodles were found to be 7.9, 5.88, 11.82, 6.67, 2.15, 3.06, 108.12 and 80.16 respectively and for Experimental Noodles V1 were found to be 8.0, 8.1, 15.5, 9.92, 7.14, 8.06, 227.43 and 115.1 respectively.***

Keywords: Noodles, Banana Peel flour, Balloon vine, By-product utilization.

1. Introduction

India is the second largest producer of wheat in the world with 86.87 million tonnes in the year 2010-11 contributing to about 12 per cent of world's wheat production. Wheat flour is used to prepare chapatti, bread, biscuits, confectionary products and noodles. Wheat based foods are very good source of carbohydrates, fibers, proteins, vitamin B and important trace minerals. They are rich in nutrients and its bran is the excellent source of dietary fiber. They also provide substances such as the lignans, alkyl resorcinol, phytosterols, phenolic acids, folates, tocopherols and tocotrienols. The biologically active components found in wheat have several health benefits. These not only help to prevent digestive disorders and cancer but also provide protection against cardiovascular diseases and help in reduction of the different health problems such as constipation, obesity, diabetes and appendicitis.

Noodles are widely consumed throughout the world. The global consumption of noodles is second only to bread. Instant noodles are a fast growing sector of the noodle industry **[1].** This is because instant noodles are convenient, easy to cook, low cost and have a relatively long shelf-life. Wheat flour which is usually used to make instant noodles is not only low in fiber and protein contents but also poor in essential amino acid, lysine. Instant noodles are dried or precooked noodles fused with oil and often sold with a sachet of flavoring. Dried noodles are usually eaten after being cooked or soaked in boiling water for 3-5 min while precooked noodles can be reheated, or eaten straight from the packet **[2].**

Food waste or by-products most commonly refers to edible food products, which are intended for the purposes of human consumption, but have instead been discarded, lost degraded or consumed by pests, and does not include the inedible or undesirable portions of food stuffs. About 38% of food wastes occur during food processing. The potentially valuable components present in foods wastes and by-products such as polysaccharides, proteins, fats, fiber, flavor compounds, phytochemicals and bioactive compounds which is beneficial to health. Efficient use of by-products greatly influences the economy of the country and environmental pollution. Proper waste management plays a vital role in the growth of food industries **[3].**

Banana (*Musa paradisiaca*) is a tropical fruit grown in over 122 countries worldwide **[4].** Global production of bananas is estimated to be around 48.9 MT. India is the largest producer of banana with a production figure of 39 thousand tons. Banana parts are used as insecticide, antioxidant, color absorber, in preparation of functional foods, wine, alcohol, biogas, cattle feed, etc. Peels are the major by-products of processing various fruit and studies show that these are good sources of polyphenols, carotenoids and other bioactive compounds which possess various beneficial effects on human health. Significant quantities of banana or plantain peels are generated as a waste product in industries producing banana based products. The peel represents around 35% of the fruit weight **[5].** Recently, flour prepared from maturated plantain peels was used as a source of antioxidant to prepare cookies **[6].** It has high levels of starch and dietary fibre. They are also agood source of lignin

(6-12%), pectin (10-21%), cellulose(7.6-9.6%), hemicelluloses (6.4-9.4%) andgalactouroninc acid. Pectin extracted from banana peelalso contains glucose, galactose, arabinose, rhamnose, and xylose.

Cardiospermumhalicacabum L. belongs to family Sapindaceae. This herbaceous plant is extensively dispersed in tropical and subtropical areas of the world. This plant is produced in the plains of Africa, America, Bangladesh, India and Pakistan. *C. halicacabum* is commonly known as Balloon vine, heart pea (England), Parol-paralon (Philippines), Jiahugua (China) and Mudakathan Keerai (TamilNadu, India). *C. halicacabum* used in Indian traditional medicine system for the treatment of rheumatism, lumbago, cough, hyperthermia, nervous diseases, stiffness of limbs and snake bite. Its extract decreases body ache. The plant based herbal products like gel, cream, shampoo, spray etc. are present in the market and are helpful in dry itchy skin and scalp **[7].**

The above properties of wheat, banana peel flour, balloon vine were utilized and its combination was optimized in the development of noodles that would aid sheeting having good physical, chemical, nutritional and rheological propertiesas well as a nutritionally enriched food product.

2. Materials and Methodology

2.1. Sample selection

The ingredients viz., banana peel and Balloon vine or modakathankeerai(*Cardiospermumhalicacabum*),wheat flour (Triticumaestivum L.), eggs and salt were procured from the local market in Chennai.

2.2. Preparation of samples

2.2.1. Preparation of banana peel flour

The banana peels were washed with clean water and cut into small pieces. The peels were sun dried for 2-3 days, ground, and stored at 27°C in a sealed polypropylene plastic bag until analyzed.

2.2.2. Preparation of Balloon vine puree

Balloon vine leaves were washed, blanched and blended into a fine puree. The puree was stored in refrigerator until use.

2.2.3. Formulation and preparation of control and experimental noodles

100% Whole wheat flour noodles were taken as control. Experimental noodles were developed with the incorporation of unripe banana peel flour and balloon vine in the (%) ratio 10:10 (V1), 15:10 (V2) and 20:10 (V3) in wheat flour (Table 1).

The ingredients were weighed and taken in a large bowl. It was followed by mixing and kneading. The dough was allowed to rest for half an hour at room temperature. It was then rolled into a thin sheet using a rolling pin. These sheets were then cut into thin strips of about 0.8 cm. They were then steamed and sun dried for 2 days.

Table 1: Composition of Control and Experimental noodles

Materials	Control	Variation - 1	Variation – 2	Variation – 3
Wheat flour (g)	100	90	85	80
Banana peel flour (g)	-	10	15	20
Balloon vine (g)	-	10	10	10
Egg (nos.)	1	1	1	1
Salt (g)	2	2	2	2

Figure 1: Experimental Noodles V1, V2, V3

3. Results and Discussion

The sensory analysis ((Flavor, appearance, color, taste, texture and overall acceptability) showed that the experimental noodles V1 was most acceptable than the other variations. The V1 scored highest in texture, aroma, after taste, flavour and overall acceptability, this is due to the incorporation of Balloon Vine and Banana Peel Flour. Hence the Control and Experimental Noodles V1 was used for further analysis. There was a significant difference in the appearance, color, flavor, overall acceptability between the control and experimental noodle variations at $p<0.05$. There was no significant difference in texture, taste, after-taste between the control and experimental noodle variations at 5% level.

The functional properties (Bulk density, water absorption, oil absorption, swelling power) for Control Noodles were found to be 0.66 (g/cm^3), 4.68 (ml/g), 1.12 (ml/g), 1.46 (ml/g) respectively and for Experimental Noodles (V1) were found to be 0.65 (g/cm^3), 4.34 (ml/g), 1.5 (ml/g), 2.06 (ml/g) respectively.

The bulk density of the experimental Noodles V1 is lesser than the Control due to the lower bulk density of the Banana peel flour and Balloon Vine than that of wheat. There was no significant difference between the control and experimental noodle variations at 5% level.

The water absorption of the experimental Noodles V1 is lesser than the Control. This is due to the addition of the Banana peel flour and Balloon Vine which decreases the water absorption capacity. There was significant difference between the control and experimental noodle variations at $p<0.05$.

The oil absorption and swelling power of the experimental Noodles V1 is higher than the Control due to the addition of the Banana peel flour and Balloon Vine. There was significant difference between the control and experimental noodle variations at $p<0.05$.

The proximate analysis (moisture %, ash %, protein g/100g, fat %, fibre %, iron mg/100g, calcium mg/100g and potassium mg/100g) for the Control Noodles were found to be 7.9, 5.88, 11.82, 6.67, 2.15, 3.06, 108.12 and 80.16 respectively and for Experimental Noodles V1 were found to be 8.0, 8.1, 15.5, 9.92, 7.14, 8.06, 227.43 and 115.1 respectively.

The moisture content of the Experimental Noodles V1 increased with the addition of the banana peel flour which is due to the increased capacity of the fiber to absorb moisture. There was significant difference between the control and experimental noodle variations at $p<0.05$.

The increase in the ash content in V1 depends on the quality of the flour and thuscorresponds to the higher mineral content, especially potassium**.** Banana contains high amounts of potassium (400 mg/100g pulp) and magnesium (34 mg/100 g edible portion contents). There was significant difference between the control and experimental noodle variations at $p<0.05$.

The protein, fat and fibre content of the V1 increased from the Control as the banana peel flour is a good source of protein, fat and fibre while Balloon Vine is rich in protein and fibre. There was significant difference between the control and experimental noodle variations at $p<0.05$.

The Iron, Calcium and Potassium content of the Experimental Noodle V1 increased as the Banana Peel Flour and Balloon Vine were incorporated which are good sources of minerals.There was significant difference between the control and experimental noodle variations at $p<0.05$.

4. Summary and Conclusion

Thus it could be summarized from the above results that incorporation of Banana Peel flour and Balloon Vine in preparation of noodles led to the development of a nutritionally adequate healthy product. This also favors the utilization of food by-products in enhancing the nutritional quality of processed foods.

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Appendix

Statistical Data of Control and Experimental Noodles

1. One way ANOVA for appearance of control and experimental noodles

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	15.6	3	5.2	24	4.1E-10	2.76943
Within Groups	12.1333	56	0.21667			
Total	27.7333	59				

2. One way ANOVA for color of control and experimental noodles

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	8.05	3	2.68333	10.6321	1.2E-05	2.76943
Within Groups	14.1333	56	0.25238			
Total	22.1833	59				

3. One way ANOVA for texture of control and experimental noodles

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.98333	3	0.32778	1.2076	0.31543	2.76943
Within Groups	15.2	56	0.27143			
Total	16.1833	59				

4. One way ANOVA for flavor of the Control and Experimental noodles.

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3.73333	3	1.24444	5.27946	0.00281	2.76943
Within Groups	13.2	56	0.23571			
Total	16.9333	59				

5. One Way ANOVA for Aroma of the Control and Experimental Noodles

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.91667	3	0.63889	2.37463	0.07979	2.76943
Within Groups	15.0667	56	0.26905			
Total	16.9833	59				

6. One way ANOVA for the Taste of Control and Experimental Noodles

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.45	3	0.15	0.47368	0.70185	2.76943
Within Groups	17.7333	56	0.31667			
Total	18.1833	59				

7. One way ANOVA for the After taste of Control and Experimental Noodles

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.58333	3	0.19444	0.4537	0.71571	2.76943
Within Groups	24	56	0.42857			
Total	24.5833	59				

8. One way ANOVA for the Overall Acceptability of the control and experimental noodles.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	8.86667	3	2.95556	16.3333	9.6E-08	2.76943
Within Groups	10.1333	56	0.18095			
Total	19	59				

Functional and Proximate Analysis

	Control	**V - 1**
Parameters	**Mean and SD**	**Mean and SD**
Moisture	7.9 ± 0.01	8.4 ± 0.01
Ash	5.88 ± 0.01	8.1 ± 0.1
Protein	11.82 ± 0.02	15.5 ± 0.02
Fat	6.67 ± 0.01	9.92 ± 0.02
Crude Fibre	2.15 ± 0.02	7.12 ± 0.05
Water Abs.	4.68 ± 0.01	4.34 ± 0.04
Oil Abs.	1.12 ± 0.02	1.5 ± 0.1
Bulk Density	0.66 ± 0.01	0.65 ± 0.01
Swelling Power	1.46 ± 0.05	2.06 ± 0.05
Iron	3.06 ± 0.04	8.06 ± 0.01
Calcium	108.12 ± 0.56	227.43 ± 0.25
Potassium	80.16 ± 1.05	115.1 ± 0.2

List of Tables

Table No.	Title
1.	Composition of Control and Experimental Noodles

List of Figures

Figure No.	Title
1.	Experimental noodles V1, V2, V3.