

Assessment of Quality Characteristics, Nutritional Attributes and Sensory Properties of Developed Amla (*Emblica officinalis*) Incorporated Products

Naveena Reddy S¹, Dr. S. Radhai Sri²

¹(Department of Nutrition & Dietetics, PSG College of Arts and Science, Bharathiar University, India)

²(Department of Nutrition & Dietetics, PSG College of Arts and Science, Bharathiar University, India)

¹Corresponding Author: naveenaofficial@gmail.com

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Abstract: Fruits on processing yield about 15 to 30 per cent of by-products which are under-utilized. Pomace is the residue or by-product that is obtained during processing of fruits and vegetables. Amla-pomace for its nutritional and functional properties can be exploited by food processing sectors for development of varieties of processed foods. Present Study aims on development of value added products using Amla-pomace. Value added products such as noodles, pasta, waffles, chocolate waffles and cookies were developed by incorporation of amla pomace. Also nutritional properties and sensory qualities were analysed for the products developed. Four variations were developed with 5, 10, 15 and 20 per cent incorporation of amla pomace. The results showed that products developed with amla-pomace are acceptable for its organo-leptic quality and nutrient composition. Amla-pomace can be utilized for product development.

Keywords: Amla Pomace, Pomace Products, Noodles, Pasta, Waffles, Cookies, Value added products, Sensory, Nutritional Value

I. Introduction

Amla (*Emblica officinalis*) commonly known as Indian Gooseberry is widely used in Indian system of medicine¹. There are several studies highlighting the importance of amla by studying its characteristics. It is the second highly cultivated fruit of India. India is one of the leading exporters of amla². In addition to its medicinal usage amla is utilized in large quantity by the food processing sectors.

According to Bhushan (2008) worldwide horticultural industries generates of the total fruits processed generates around 25%-40% (of totally processed fruits)³. Amla juice is used in several food and beverage processing such as powder drink mixes, nutritional bars, jams and others. This leaves amla-pomace as major product generated during juice extraction process. Despite the use of amla in food industry the amla-pomace utilization is relatively very low.

This study was undertaken with the primary aim of utilizing amla-pomace for the development of value added products including Noodles, Cookies, Waffles, Chocolate Waffles and Pasta. For the most acceptable product and standard, nutritional composition and sensory qualities were identified.

II. Material And Methods

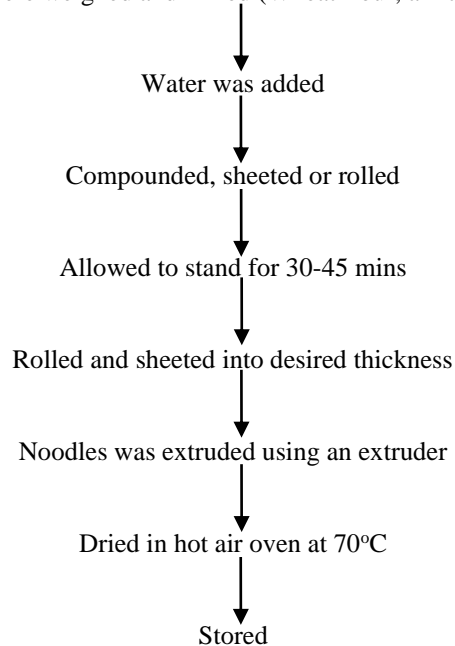
Procurement of raw materials: Primary raw material amla-pomace was sourced from Food Processing Centre, PSG College of Arts & Science, Coimbatore district and other ingredients were procured from the nearest local market of Coimbatore district, Tamil Nadu.

Processing of Amla-pomace: Amla-pomace after procurement was weighed and spread evenly in oven plates and dried at 80°C for 16 hours. The dried amla-pomace was weighed, powdered, sieved and stored in air tight covers for prevention of any oxidative damage.

Development of value added products by incorporation of amla pomace: Five products namely noodles, pasta, waffles, chocolate waffles and cookies were made by incorporating amla-pomace.

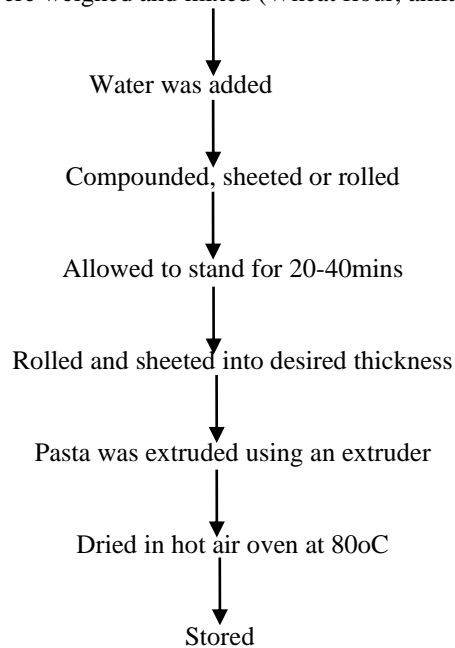
Development of amla pomace incorporated noodles

All ingredients were weighed and mixed (Wheat flour, amla pomace and salt)



Development of amla pomace incorporated pasta

All ingredients were weighed and mixed (Wheat flour, amla pomace and salt)



Development of waffle by incorporating amla pomace: Waffle is a crisp golden brown pancake with deep indentations on both sides. Melt the butter (50g) in a saucepan. In a large bowl, combine and mix well the milk (200

ml), flour (200 g), egg (1 medium size) and baker's yeast (previously mix the yeast with a bit of milk). Add the melted butter. Separately, beat the egg whites with the salt and when stiff, add to the rest of the ingredients, folding it in. Open the waffle machine and spray oil on the bottom and top plates. Pour the batter into the bottom plate. Close the waffle maker. Baking time: 3 to 5 min at 450° F. After 3 min, open the waffle machine and remove a golden waffle with the waffle fork.

Development chocolate waffle: Melt the butter (50g) in a saucepan. In a large bowl, combine and mix well the milk (200 ml), flour (200 g), egg (1 medium size) and baker's yeast (previously mix the yeast with a bit of milk). Add the melted butter. Separately, beat the egg whites with the salt and when stiff, add to the rest of the ingredients, folding it in. Open the waffle machine and spray oil on the bottom and top plates. Pour the batter into the bottom plate. Close the waffle maker. Baking time: 3 to 5 min at 450° F. After 3 min, open the waffle machine and remove a golden waffle with the waffle fork. Allow it to cool and then slice the waffles to desire size and melted milk chocolate was coated over it and packed.

Development of cookies by incorporating amla pomace: Wheat flour, butter and sugar were procured from the local market. All the raw material was properly measured according to the ratio required in cookies. The wheat flour was sieved through fine sieves to avoid the dirt and unwanted particles. Then the butter (47 g) was creamed for 10 minutes to obtain a creamy and even texture of butter. Sugar (15 g) was added to the butter and mixed gently until the sugar was dissolved and a foamy consistency was obtained. The weighed wheat flour was added. Dough was prepared and kept aside whereas, on the other side, the oven was preheated at 150o C for 20 minutes. The prepared dough was shaped for baking. The baked cookies were packed in an airtight container⁴.

For all the 5 products a standard (S) without amla-pomace was considered as standard and four variations were made by replacing 5 (V₁), 10 (V₂), 15 (V₃) and 20 (V₄) percent of amla-pomace in proportion to the wheat flour.

Quality Characteristics of the developed value added products: Moisture and ash content were analyzed using AOAC (2007) method⁵. The cooking qualities like cooking loss (%), weight and volume increase (%) were performed for the value added noodles and pasta variations. A 10 g of pasta and noodles were placed into 300 ml of boiling distilled water. After 10, 20 and 30 min, samples were removed, washed with distilled water and drained for 2 min.

Nutritional Analysis of the developed value added products: Nutrients such as carbohydrates, protein, fat, fibre and vitamin C in formulated amla-pomace incorporated products were analyzed in triplicates.

Estimation of Carbohydrates: The amount of carbohydrate was analysed by using Hedge and Hofrieter (1962) method⁶.

Estimation of Protein: Protein was estimated using kjeldahl process (AOAC 2007) in which the proteins along with other organic food particles are digested with Conc. H₂SO₄ in presence of catalyst (1:5 cupric sulphate : sodium sulphate). The total Nitrogen gets converted to Ammonium Sulphate. The digested sample is diluted with water then alkali (NaOH) is added to neutralize H₂SO₄. The formed ammonia is distilled into H₂SO₄ solution which has methyl red indicator. The protein content in pomace was obtained by multiplying with 6.25, the nitrogen value⁵.

Estimation of Fat: Fat content of amla pomace was determined by following Soxhlet Plus apparatus by using petroleum ether.

Estimation of Fibre: Crude fibre for the value added products was determined according to AOAC (2007) method⁵.

Estimation of Vitamin C: Ascorbic acid content of amla pomace was determined by following standard titration method using 2, 6-dichlorophenol indophenols (BDH) dye solution (0.4 %) which was standardized against standard ascorbic acid (AOAC, 2007)⁵.

Statistical analysis: The data regarding the analytical aspects of amla pomace and amla pomace incorporated value added products were statistically analysed to draw meaningful results using SPSS software and MS Excel (2010).

III. Result

Prepared products were evaluated for sensory attributes like Appearance, Colour, Flavour, Body/Texture and Overall acceptability by a panel of 30 semi-trained judges⁷. The samples were rated on 9 point Hedonic Rating Scale and most acceptable sample was selected for analysis. The table no 1 gives the scores and SD obtained by each product.

Table no 1: Mean Scores and Standard Deviation of Sensory Attributes of Amla-pomace incorporated products

Products	Criteria				
	Colour & Appearance	Flavour	Texture	Taste	Overall Acceptability
Noodles (N)					
NS	8.92 ± 0.08	8.96 ± 0.04	8.96 ± 0.04	8.92 ± 0.08	8.96 ± 0.04
NV ₁	8.0 ± 1.0	7.96 ± 1.02	7.92 ± 1.00	7.96 ± 0.08	8.0 ± 0.25
NV ₂	8.04 ± 0.66	8.0 ± 0.64	8.04 ± 0.56	7.96 ± 0.07	8.0 ± 1.0
NV ₃	7.96 ± 0.80	7.80 ± 0.86	7.76 ± 0.42	7.12 ± 0.23	7.52 ± 0.45
NV ₄	7.92 ± 0.65	7.40 ± 0.86	6.24 ± 2.04	6.68 ± 2.2	6.76 ± 2.06
Pasta (P)					
PS	8.76 ± 0.001	8.64 ± 0.02	8.72 ± 0.002	8.72 ± 0.004	8.72 ± 0.02
PV ₁	8.60 ± 0.2	8.0 ± 1.0	7.80 ± 1.02	7.48 ± 1.22	7.80 ± 0.9
PV ₂	8.64 ± 0.02	8.04 ± 0.24	7.84 ± 1.02	7.40 ± 1.22	7.96 ± 0.9
PV ₃	8.60 ± 0.04	7.96 ± 0.08	7.80 ± 0.24	6.84 ± 1.24	6.92 ± 1.32
PV ₄	8.64 ± 0.08	7.80 ± 0.24	6.72 ± 1.32	6.0 ± 1.24	6.28 ± 1.32
Waffles (W)					
WS	8.72 ± 0.24	8.56 ± 0.24	8.76 ± 0.22	8.56 ± 0.32	8.52 ± 0.22
WV ₁	8.72 ± 0.22	8.52 ± 0.34	8.60 ± 0.36	8.24 ± 0.2	8.32 ± 0.12
WV ₂	8.76 ± 0.12	8.40 ± 0.22	8.72 ± 0.14	8.28 ± 0.25	8.36 ± 0.36
WV ₃	8.72 ± 0.08	8.60 ± 0.10	8.80 ± 0.4	8.52 ± 0.32	8.60 ± 0.24
WV ₄	8.76 ± 0.08	8.52 ± 0.32	8.44 ± 0.12	8.36 ± 0.12	8.28 ± 0.28
Chocolate Waffles (CW)					
CWS	8.96 ± 0.04	9	8.92 ± 0.08	8.96 ± 0.04	9
CWV ₁	8.68 ± 0.14	8.84 ± 0.6	8.72 ± 0.12	8.84 ± 0.8	8.76 ± 0.8
CWV ₂	8.64 ± 0.18	8.76 ± 0.8	8.76 ± 0.4	8.84 ± 0.4	8.74 ± 0.8
CWV ₃	8.72 ± 0.14	8.88 ± 0.8	8.84 ± 0.12	8.88 ± 0.8	8.80 ± 1.6
CWV ₄	8.68 ± 0.4	8.84 ± 0.8	8.80 ± 0.8	8.88 ± 0.4	8.76 ± 0.8
Cookies (C)					

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CS	8.84 ± 0.8	9	8.52 ± 1.2	8.68 ± 1.8	8.72 ± 1.2
CV ₁	8.0 ± 1.0	7.96 ± 1.02	7.92 ± 1.00	7.96 ± 0.08	8.0 ± 0.25
CV ₂	8.04 ± 0.66	8.0 ± 0.64	8.04 ± 0.56	7.96 ± 0.07	8.0 ± 1.0
CV ₃	7.96 ± 0.80	7.80 ± 0.86	7.76 ± 0.42	7.12 ± 0.23	7.52 ± 0.45
CV ₄	7.92 ± 0.65	7.40 ± 0.86	6.24 ± 2.04	6.68 ± 2.2	6.76 ± 2.06

On assessing the scoring of variations in accordance with standard NV₂, PV₂, WV₃, CWV₃ and CV₂ were selected as most acceptable ones. In no case variation 1 and 4 with 5% and 20% incorporation were highly acceptable respectively. Panel judges said that they liked the mild flavour and taste exhibited by products with 10% incorporation.

For the selected variations quality characteristics (table no 2) and nutritional composition (table no 3) studied against their standards are given.

Quality Characteristics of the developed value added products: Moisture content is crucial for products as moisture content is directly proportional to the water activity which in turn influences the rate of microbial growth. Ash value is the reflection of minerals such as sodium, potassium, zinc, cobalt and others present. The analyzed moisture and ash contents are compared with respect to FSSAI standards in table 2 for both standard and most accepted variation.

Table no 2: Quality Characteristics

S. No.	Products	Moisture (%)	FSSAI standard Moisture value (2.4.10) (%)	Ash content (g/100 g)	FSSAI standard value (2.4.10) (%)
1.	NS	10.35 ± 0.02	Not more than 13	1.95 ± 0.01	Not more than 0.3
2.	NV ₂	10.10 ± 0.01	Not more than 13	1.20 ± 0.01	Not more than 0.3
3.	PS	9.25 ± 0.05	Not more than 12.5	1.94 ± 0.005	Not more than 0.1
4.	PV ₂	9.15 ± 0.04	Not more than 12.5	1.23 ± 0.004	Not more than 0.1
5.	WS	17.66 ± 0.12	-	1.85 ± 0.015	-
6.	WV ₃	17.21 ± 0.1	-	1.25 ± 0.0	-
7.	CWS	18.50 ± 0.23	-	1.95 ± 0.02	-
8.	CWV ₃	18.25 ± 0.35	-	1.90 ± 0.04	-
9.	CS	2.19 ± 0.045	-	0.45 ± 0.001	-
10.	CV ₃	2.05 ± 0.05	-	0.40 ± 0.001	-

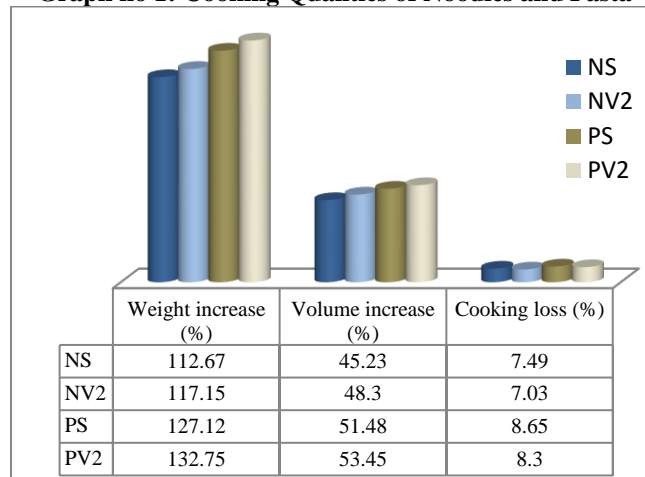
Moisture content of pomace incorporated highly acceptable products was lower than that of their respective standards. Between ash content and percentage of amla incorporation there existed a negative correlation (r₂ = 0.783) but the correlation was insignificant as p>0.05. On increasing the percentage of amla pomace incorporation the g per cent of ash content decreased.

FSSAI do not provide standard for waffles and cookies and hence comparison is possible only for noodles and pasta. Both noodles and pasta did not meet their standard regulation in respect to ash, as the prepared products have high amount of ash indicating the presence of minerals, whereas, moisture content of noodles and pasta standards and variations satisfied the FSSAI standards.

Cooking quality of noodles and pasta: Cooking quality was assessed only for noodles and pasta as other products was ready to eat foods.

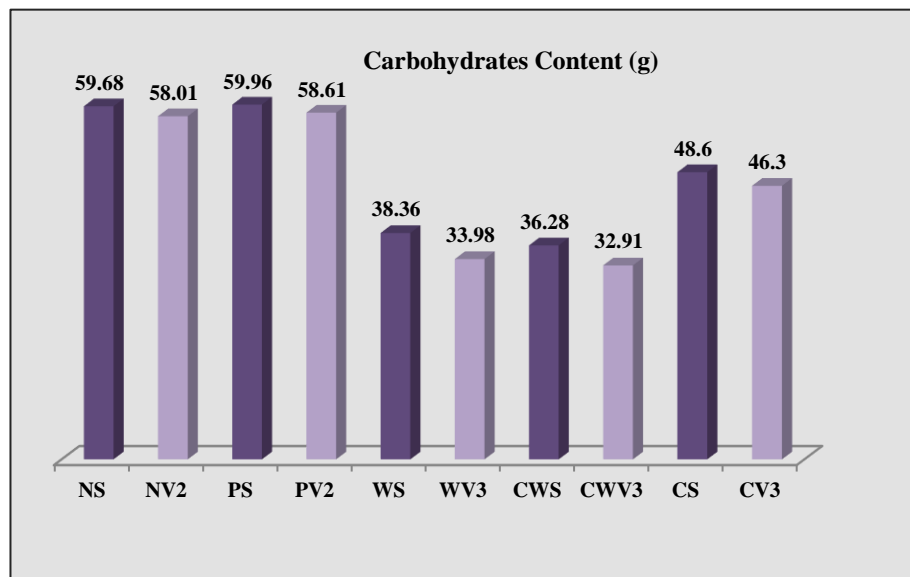
Graph no 1 conceals that the percentage of weight increase was higher in NV₂ and PV₂ when compared to NS and PS. Volume increase (%) was also greater in pomace incorporated noodles and pasta in comparison with their respective standard while on contrary cooking loss percentage was lesser in amla pomace incorporated noodles and pasta than their standard.

Graph no 1: Cooking Qualities of Noodles and Pasta



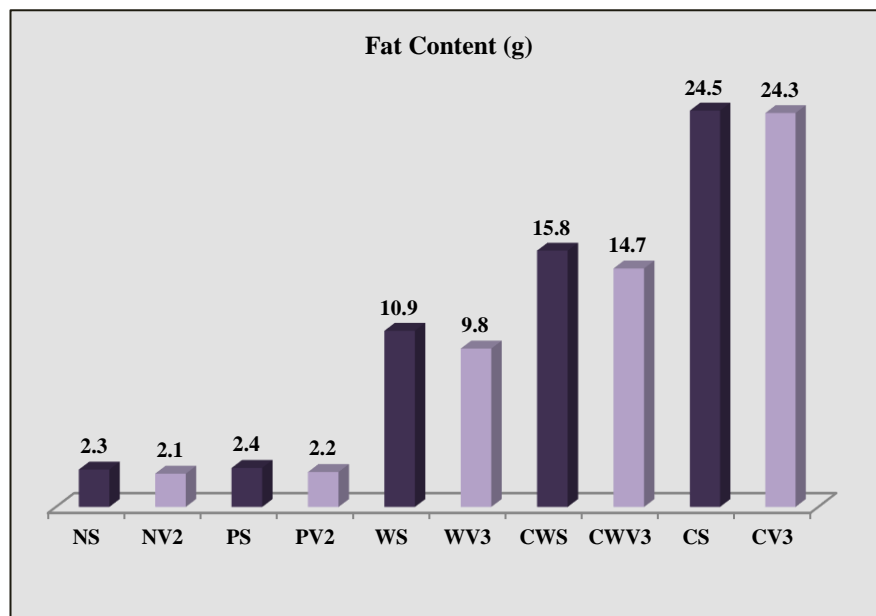
Graph no 2 shows the comparison chart of carbohydrates content of standards and selected variations. All variations had lesser amount of carbohydrates as wheat flour was replaced by amla-pomace.

Graph no 2: Percentage of carbohydrates in standards and selected variations



Graph no 3 indicates the fat content and shows that amla-pomace incorporated products' fat content is inferior to the standards.

Graph no 3: Percentage of fat content in standards and selected variations



Graph no 4 provides data on protein content of the product's standards and selected variations. Protein content of standards was higher than variations as certain percent of wheat flour was substituted by amla-pomace.

Graph no 4: Percentage of protein in standards and selected variations

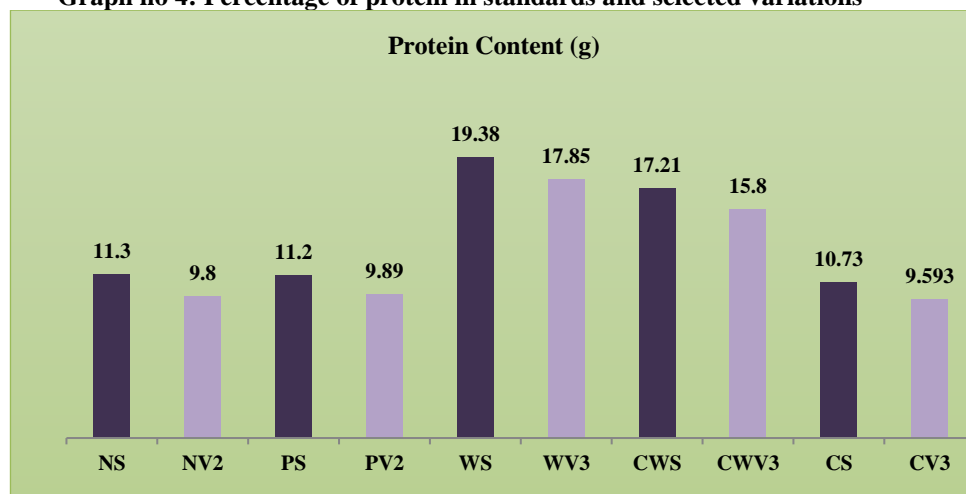


Table no 3: Amount of vitamin C and Crude Fibre of Standard and Selected Variations

Nutrients	NS	NV ₂	PS	PV ₂	WS	WV ₃	CWS	CWV ₃	CS	CV ₃
Crude fibre (g)	11.4	14.16	11.25	14.96*	10.34	16.95*	8.25	14.23*	10.92	15.5*
Vitamin C (mg)	0	6.5*	0	6.35*	0.80	2.8	0.6	1.3	0	5.1*

* indicates significant difference in value (p<0.05)

Table no 3 indicates that there was significant increase in the amount of vitamin C for pomace added noodles, pasta and cookies with respect to standard while fibre content significantly increased in pomace incorporated pasta, waffles, chocolate waffles and cookies. Percentage of pomace incorporation and fibre showed positive correlation ($r^2 = 1.000$). Fibre content increased with increase in percentage of pomace while positive correlation also existed between percentage of pomace incorporation and vitamin C content ($r^2 = 0.993$).

IV. Discussion

The carbohydrates content was increased while fat and protein content decreased on increasing the pomace concentration in biscuits⁸ whereas in case of this current study carbohydrates, fat as well as protein contents decreased in selected variations than standards.

The fibre content of PV₂ (14.96 g) of this study was very much higher than class Italian pasta as mentioned in a study on pasta properties⁹.

The fibre content of amla pomace incorporated cookie was almost 5 times greater in amla pomace incorporated cookies (15.5) than carrot pomace added cookies (3.2g)¹⁰. The fibre content of optimized multigrain noodles and Maggie noodles were only 4.78 and 0.51 per cent and the vitamin C content was nil¹¹.

Amount of ascorbic acid (5.1mg/ 100g) was higher in amla pomace added product than the one made with grape pomace which was only 2.1mg as mentioned in a study¹². The protein content of amla pomace incorporated cookies was higher with 9 per cent when compared to that of raspberry pomace gluten free cookies¹³.

From the paired t test made using SPSS, it was found that significant level of difference existed between standard and pomace incorporated products in case of fibre and vitamin C content ($p < 0.05$). The fibre content increased on addition of beet pomace powder as reported in a study¹⁴.

In this study result of increased fibre content was because of the incorporated amla pomace whose crude fibre content was more than 39g per 100g. On calculating two-tailed paired t- test the difference in fibre and vitamin C content between the standard and variation were significant ($t = 71.621$). The reduced amount of vitamin C in pomace waffles chocolate was because; the product got subjected to 450° C. As a result of heat the amount of vitamin C lowered as it is heat liable in nature. However, ascorbic acid content was greater in product being 1.3mg while standard had 0.6mg.

V. Conclusion

Food industry that has fruits as primary ingredients provides opportunity to invest initiatives to reduce wastage levels and to better utilize the wastes generated from food manufacturing. In the present study, amla-pomace (by-product of amla juice processing) with significant amount of crude fibre and vitamin C was better utilized to formulate value added products including noodles, pasta, waffles, waffle chocolate and cookies. Furthermore, the study can be extended by packing & labeling the products and analyzing the market potential for commercialization.

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