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Utilization of amaranth grain flour at different products and its acceptability

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Abstract

Amaranth grain is very nutritious pseudo-cereal with high protein content as compared to the true cereals which is also gluten-free. Amaranth grain is a rich source of carbohydrate, protein, lipids, energy, and dietary fiber and has significantly higher content of lysine and acceptable level of tryptophan and methionine than other cereal and leguminous grains of common usage. The aim of the study is to developed value added products from amaranth grain flour at different levels and its acceptability. Roasted amaranth grain flour (RAGF), popped amaranth grain flour (PAGF) and soaked amaranth grain (SAG) were incorporated in different products. RAGF was incorporated in cake at 5, 10, 15, 20, and 50 %. Overall acceptability of cake with 5, 10, 15, 20 and 50% of RAGF were 8.6, 8.3, 8.2, 8.2 and 8.2 respectively. PAGF was incorporated in besan burfi at 5, 15, 20, and 50% with respect to 8.2, 8, 7.6, 7.9 respectively; coconut ladoo at 10 and 20% w.r.t. 7.8 and 7.4 respectively and Cashewnut burfi at 10, 15 and 50% w.r.t. 7.2, 7.8, 7.6 respectively. SAG were incorporated in dosa at 10 and 20%. The average score for overall acceptability was 7.7 and 7.6 respectively. The sensory acceptability was done by 30 semi-trained panels on nine point hedonic rating scale.

Keywords: amaranth grain, value added product, sensory evaluation

Introduction

In India, the amaranth grain are commonly known as Rajgira (king seed), Ramdana (seed sent by god) is known to be very nutritious pseudo-cereal with high protein content as compared to the true cereals which is also gluten-free (Bhat *et al.*, 2015; Sneha and Haripriya, 2018) [2, 19]. Amaranth belongs to the family *Amaranthaceae*. The word amaranthus is derived from the Greek word “anthos” (flower) which means everlasting or unwilting (Rastogi and Shukla, 2013) [14]. The genus amaranth is mainly comprised of about 400 species among which few of them are found throughout the world in temperate, sub-tropical and tropical climate zones (Suma *et al.*, 2002) [20]. Based on their utilization method the species is divided into grain amaranth, vegetable amaranth, ornamental and weedy amaranth (Sauer, 1967) [16]. India is one of the centers of distribution of amaranth, the other centre being tropical America. About 20 species are found cultivated in India (Rastogi and Shukla, 2013) [14]. The most species widely use amaranth grains are: *Amaranthus cruentus* L., *Amaranthus hypochondriacus* L. and *Amaranthus caudatus* L. (Pablo *et al.*, 2011) [13]. Amaranth grain is a rich source of carbohydrate, protein, lipids, energy, and dietary fibre and has significantly higher content of lysine and acceptable level of tryptophan and methionine than other cereal and leguminous grains of common usage (Bressani, 1989; Teutonica & Knorr, 1985) [3, 21]. Protein concentration of amaranth is in between a range of 12.5% or 17.5% (Teutonica & Knorr, 1985) [21]. The amount of protein present in amaranth grain has a superior amino-acid profile compare to other plant foods. Similarly it has twice the level of calcium in milk, five times the level of iron in wheat and higher in sodium, potassium, and vitamins A, E, C, and folic acid than cereals grains (Becker *et al.*, 1981) [1]. The grains also content high vitamin and mineral contents, such as riboflavin, niacin, ascorbic acid, calcium, magnesium and low level of anti-nutritional factors (Zapotoczny *et al.*, 2006) [23]. Amaranth grain consists of 6 to 9 percent oil which higher than most other cereals. The total carbohydrate present in amaranth grain excluding its crude fiber is 33.67 percent (*i.e.* 66.33 percent including fiber) (Emire and Arega, 2012; Monica *et al.*, 2011) [6, 10] reported the carbohydrate content of amaranth is 62.9 percent). The carbohydrates present in amaranth grain consist primarily of starch made up of both glutinous and non-glutinous fractions.

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The unique aspect of amaranth grain starch is that size of the starch granules (1 to 3 μm) are smaller than found in other cereal grains (Becker *et al.*, 1981) [1]. Amaranth starch has higher water binding capacity, higher sorption capacity at higher water activity values, as well as higher solubility, higher swelling power and enzyme susceptibility (Singhal and Kulkarni, 1990) [18]. Additionally, amaranth grain has been shown to exhibit antioxidant activity and this has been attributed to its content of polyphenols, anthocyanins, flavonoids, and tocopherols (Escudero *et al.*, 2011) [7]. It has various health benefits include decreasing plasma cholesterol levels, stimulating the immune system, exerting an anti-tumour activity, reducing blood glucose levels and improving conditions of hypertension and anaemia. Moreover, it has been reported to have anti-allergic activities (Caselato and Amaya, 2012) [5]. The amaranth is gluten free and easy to digest and the grain 90 percent digestible because of its ease of digestion (Morales *et al.*, 1988) [11]. A variety of heat processing methods can be applied to grain amaranth, in preparation for the consumption. Heat processing affects the nutritional value of foods (Rehman and Shah, 2005) [15], and also affects the level of phyto-chemicals (Xu *et al.*, 2007) [22] and functional properties (Muyonga *et al.*, 2007) [12].

Materials and Methods

The grains of amaranth with pale brown color and all the ingredients required for the formulation were procured from local supermarket, Tura, Meghalaya.

Preparation of Amaranth Flour

Dry roasting of Amaranth grains

For roasting, amaranth grains were heated on a hot pan at high flame for 4-5 minutes until the color of the grain change to golden yellow and flavor produced. The grains were stirred in a regular interval. The roasted grains were cooled and milling was done by electrical grinder at high speed uniform particle size flour. The obtained flour was sieve and stored in air tight container.

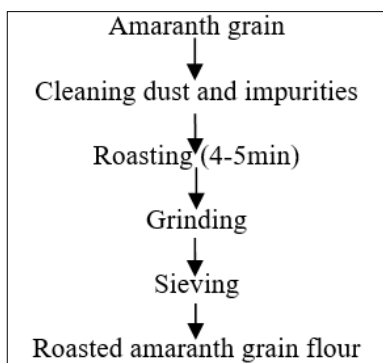


Fig 1: Flow chart of RAGF



Plate 1: Roasted Amaranth grain and Flour

Popping of Amaranth grains

According to Teutonica and Knorr, 1985 [21] the grains were clean and washed thoroughly. The grains were placed in a hot stainless steel pan of about 220 °C for 10-20 seconds or until they popped. The grains are stirred continuously to prevent them from burning while popping. Saunders and Becker, 1984 reported that popping amaranth grains increase the volume of up to 1050 % and gives the grains a gritty flavor. Similar procedures were followed for this study. The popped grains were cooled and ground to fine flour by using electrical grinder and stored in air tight container.

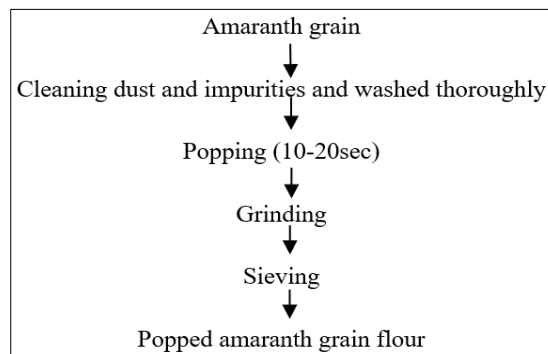


Fig 2: Flow chart of PAGF

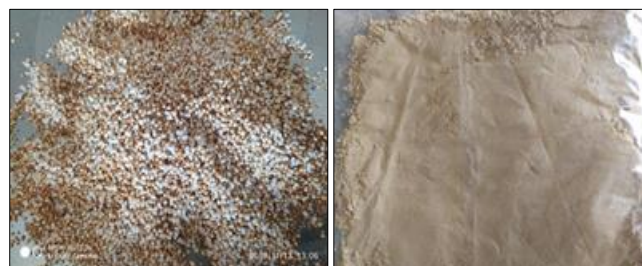


Plate 2: Popped Amaranth grain and Flour

Soaking of Amaranth Grains

The grains were clean dust and impurities. Place the grain in a bowl and soak for 2-3 hrs. Rinse and pour off water before grinding. The soaked grains were ground by using electrical grinder.

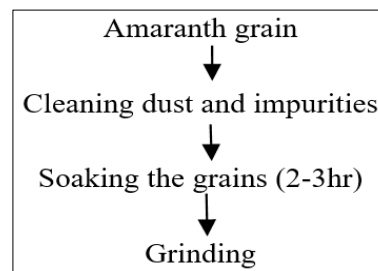


Fig 3: Flow chart of SAG



Plate 3: Soaked amaranth grain

Product Development

Roasted amaranth grains flour (RAGF), popped amaranth grains flour (PAGF) and soaked amaranth grains (SAG) were incorporated in different products. The levels of incorporation were selected for this experiment conducted to determine the suitability of the proportion. The food products namely cake, besan burfi, coconut laddoo, and cashew nut burfi were developed by incorporation of various levels of either amaranth grain flour or amaranth grain. The detailed of the developed products are presented in Table 1

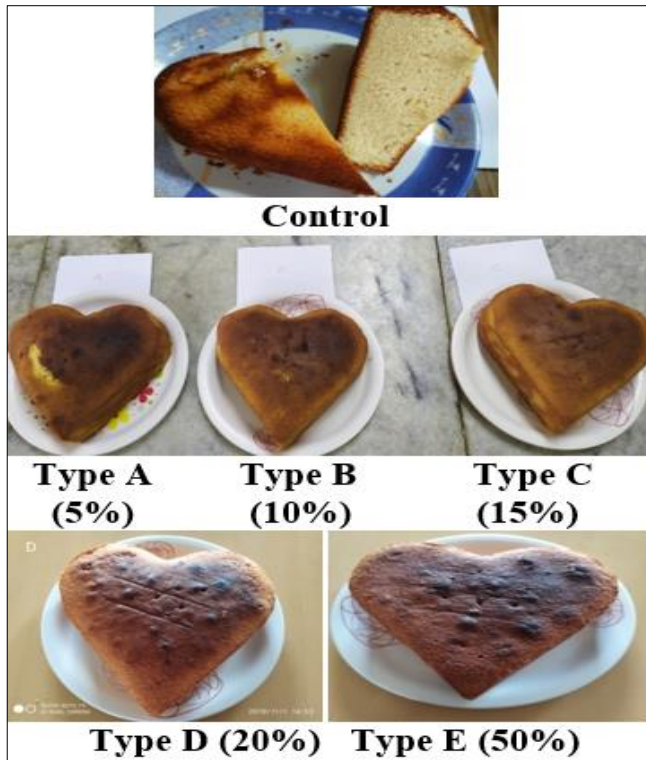


Plate 4: Cake incorporated RAGF

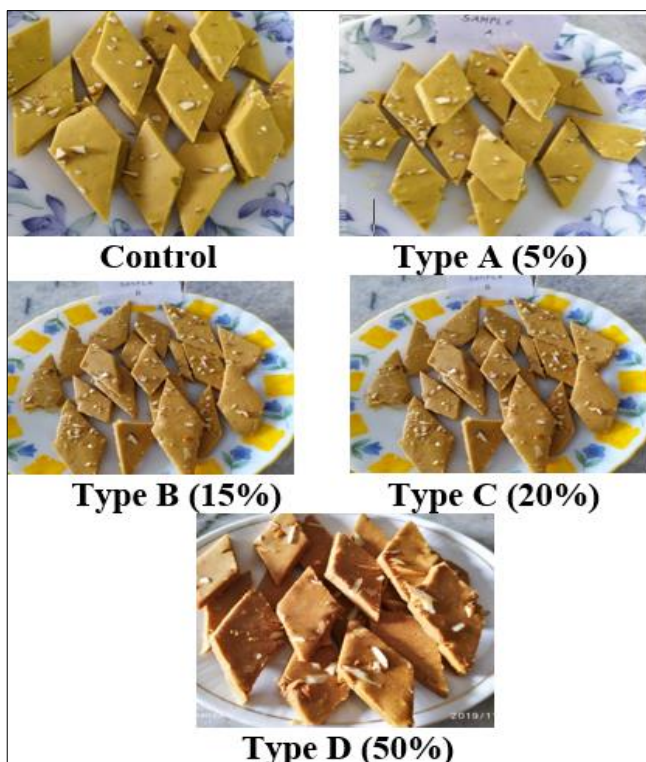


Plate 5: Besan burfi incorporated PAGF

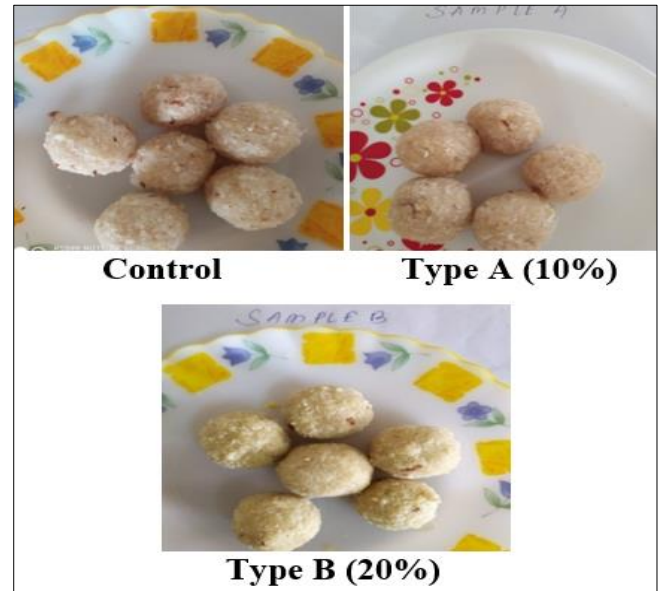


Plate 6: Coconut laddoo incorporated PAGF

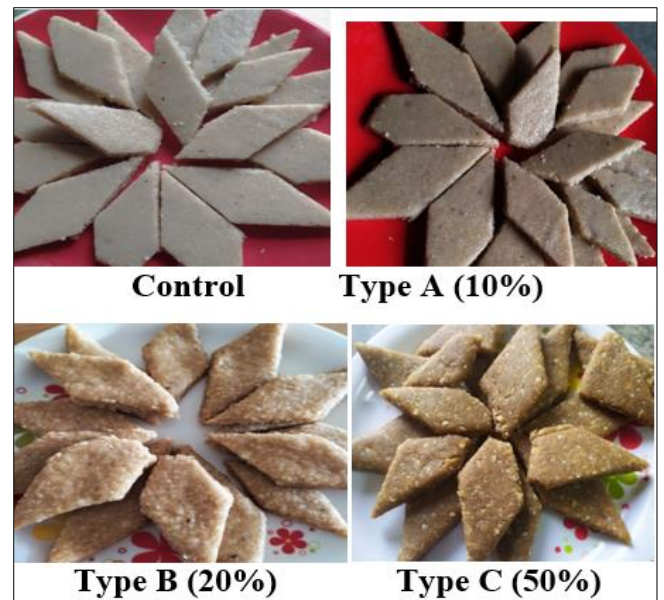


Plate 7: Cashewnut burfi incorporated PAGF

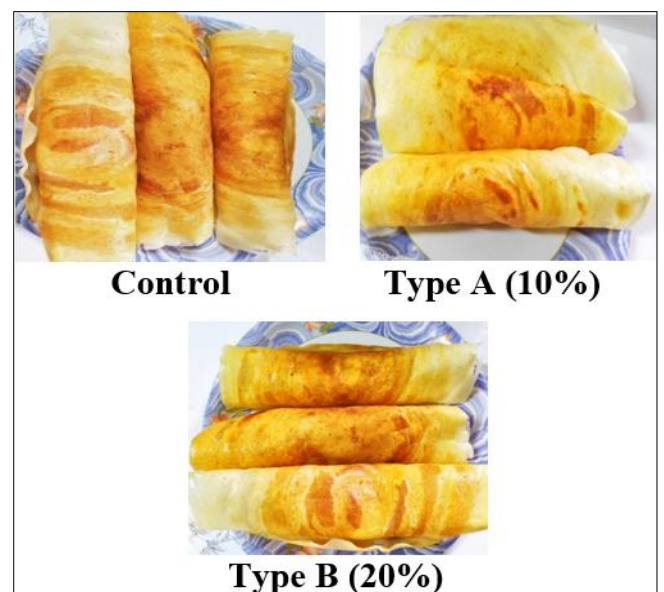


Plate 8: Dosa incorporated SAG

Sensory Evaluation

The developed products were evaluated for their sensory characteristics by a panel of thirty semi-trained panelists from the Department of Food and Nutrition, teaching staffs, non-teaching staff and final year students of Food Science and Nutrition & Nutrition and Dietetics of College of Community Science Central Agricultural University, Tura Meghalaya. The panelist judges on nine point Hedonic scale on the basis of their appearance, texture, aroma and taste where 9 indicated “like extremely” and 1 indicated “dislike extremely”.

Statistical Analysis

The data obtained from various parameters were recorded and statistically analyzed. Mean and standard deviation for the various parameters were computed by using Microsoft excel software programme.

Results and Discussion

The products were developed by incorporating different proportion of amaranth flour. The developed products such as Cake, Besan burfi, coconut laddoo, cashew nut burfi and Dosa were evaluated. The mean score of sensory evaluation are shown in Table 2

Sensory Attributes and Overall Acceptability

Cake was formulated by incorporating roasted amaranth grain flour (RAGF) in order to enhance the nutritional value and for achieving maximum sensory attributes (Table 2). Cake without incorporation of RAGF was used as a control sample. Mean scores of appearance for cake developed from different proportion RAGF was ranging from 7.5 to 8.0. Among the varying level of incorporation of RAGF in cake, Type A (5%) 8.4 was the most acceptable followed by Type B (10%) 8.3, Type C (15%) 8.2, Type D (20%) 8.2 and Type E (50%) 8.1. It was observed that all the types of cake were acceptable in terms of appearance, texture, taste, aroma and overall acceptability which fell in the category of “Like very much”. Shyam and Raghuvanshi (2013) [17] reported that incorporation of 40% amaranth flour was the most acceptable amaranth eggless cake. It was more preferred than the control cake. However, they prepared eggless cake with the constant level of whey protein concentrate and using sun dried followed by oven dried amaranth grain flour. Capriles *et al.*

(2008) [4] evaluated the effects on physical and sensory properties of regular and reduced fat pound cakes and reported that with the increasing level of amaranth flour darkened the crust and crumbs of cakes, which decrease the color acceptability. Besan burfi was prepared by incorporating popped amaranth grain flour (PAGF). Four different types of besan burfi was developed and without PAGF used as control sample. The mean score of overall acceptability for Type A (5%), B (15%), C (20%) & D (50%) were 8.2, 8.0, 7.6 & 7.9 respectively. Type A was the most acceptable besan burfi with respect to appearance 8.4, texture 8.2, taste 8.3, aroma 8.2 and overall acceptability 8.2 score. Two different types of coconut laddoo were developed by incorporating popped amaranth grain flour (PAGF). The mean scores of overall acceptability for type A (10%) and Type B (20%) were 7.8, 7.4 respectively. According to the Table 2 the overall acceptability were similar in control and Type A which fell in the category of “like moderately” followed by Type B. Cashewnut burfi was also prepared by substituting popped amaranth flour at varying proportion (Table 2). The control Cashewnut burfi had highest mean scores followed by Type B (15%), Type C (50%) and Type A (10%). However, there is no much difference between the samples therefore, clearly shows that the suitability of amaranth flour incorporation up to 50% in Cashewnut burfi was acceptable. Dosa was formulated by incorporating soaked amaranth grain (SAG) at 10% (Type A) & 20% (Type B) level and without SAG was used as a control sample. The averages mean score for overall acceptability were 7.7, 7.6 and 7.4 respectively. Formulated dosa incorporating 10% (Type A) SAG was the highest acceptability as compare to 20% (Type B) followed by control sample. Sneha & HariPriya (2018) [19] developed amaranth grain based instant dosa mix and its quality characteristics by roasting and germination method. They reported that sensory evaluation revealed that all the samples score similar for all the attributes and recommend germination of amaranth grain for its better nutritive value (Jauregui *et al.*, 2003) [8] reported that snacks developed with pure amaranth was highly acceptable and had enhanced the quality of nutrition. Kowsalya and Indra (2010) [9] reported that development of extruded products from amaranthus incorporated nutritious mix were highly acceptable from the sensory evaluation of commonly consumed recipes.

Table 1: Standardized recipes for roasting amaranth grain flour (RAGF), popping amaranth grain flour (PAGF) and soaked amaranth grain (SAG)

Recipe	Level of incorporation	Ingredients(g)						
		Wheat flour	RAGF	Powdered sugar	Butter	Egg	Baking powder	Vanilla
Cake	Control	100	-	100	100	3	1tsp	Few drops
	Type A (5%)	95	5	100	100	3	1tsp	Few drops
	Type B (10%)	90	10	100	100	3	1stp	Few drops
	Type C (15%)	85	15	100	100	3	1tsp	Few drops
	Type D (20%)	80	20	100	100	3	Tsp	Few drops
	Type E (50%)	50	50	100	100	3	1tsp	Few drops
Besanburfi	Control	Bengal gram flour	PAGF	Powder sugar	Ghee	Almond/Cardamom powder		
	Type A (5%)	150	-	70	75	20/a pinch		
	Type B (15%)	145	5	70	75	20/a pinch		
	Type C (20%)	135	15	70	75	20/a pinch		
	Type D (50%)	130	20	70	75	20/a pinch		
Coconut laddoo	Control	Coconut fresh	PAGF	sugar	Milk powder	Almond		
	Type A (10%)	100	-	35	5	5		
	Type B (20%)	90	10	35	5	5		
		80	20	35	5	5		

Cashewnut burfi	Control	Cashewnut	PAGF	Sugar	Ghee	Cardamom powder
	Type A (10%)	150	-	75	5	1 tsp
	Type B (15%)	140	10	75	5	1 tsp
	Type C (50%)	135	20	75	5	1 tsp
	Type C (50%)	75	50	75	5	1 tsp
Dosa	Control	Parboiled rice	Raw rice	Black gram dhal	SAG	Fenugreek seed
	Type A (10%)	110	20	75	-	5
	Type B (20%)	100	20	75	10	5
	Type B (20%)	90	20	75	20	5
	Type B (20%)	90	20	75	20	5

RAGF- Roasted amaranth grain flour PAGF- Popped amaranth grain flour SAG- Soaked amaranth grain

* Salt used as required for the taste

Water used as needed

Table2: Sensory evaluation of incorporated roasted amaranth grain flour, popped amaranth grain flour and soaked amaranth grain product at different level

Product	Appearance	Texture	Taste	Aroma	Overall acceptability
Cake					
Control	7.5±0.51	7.2±0.45	8.0±0.37	7.2±0.45	8.0±0.37
Type A (5%)	8.1±0.83	8.2±0.67	8.0±0.70	8.2±0.70	8.4±0.50
Type B (10%)	8.2±0.70	8.2±0.70	8.2±0.79	8.0±0.70	8.3±0.72
Type C (15%)	8.0±0.70	7.9±1.27	7.9±0.45	8.0±0.59	8.2±0.67
Type D (20%)	7.7±0.59	8.0±0.70	8.2±0.59	8.3±0.48	8.2±0.41
Type E (50%)	7.4±0.63	7.7±0.70	8.0±0.59	8.2±0.41	8.1±0.35
Besan burfi					
Control	7.8±0.69	7.8±1.08	8.3±0.59	7.9±0.66	8.0±0.70
Type A (5%)	8.4±0.74	8.2±0.77	8.3±0.81	8.2±0.67	8.2±0.77
Type (15%)	8.2±0.56	7.8±0.69	8.1±0.74	8.0±0.70	8.0±0.65
Type (20%)	7.7±0.64	7.8±0.58	7.8±0.72	7.7±0.74	7.6±0.50
Type (50%)	7.4±0.59	7.6±0.41	7.9±0.51	7.7±0.59	7.9±0.50
Coconut laddoo					
Control	7.8±0.51	7.8±0.77	7.8±0.63	7.6±0.59	7.8±0.51
Type (10%)	7.7±0.59	7.6±0.79	7.2±0.70	7.6±0.72	7.8±0.74
Type (20%)	7.7±0.45	7.1±0.35	7.6±0.50	7.3±0.50	7.4±0.51
Cashewnut burfi					
Control	7.8±0.35	7.6±0.50	8±0.53	7.8±0.51	7.8±0.35
Type (10%)	6.4±0.50	6.8±0.67	7.4±0.50	7.4±0.51	7.2±0.45
Type (15%)	7.4±0.63	7.5±0.51	7.8±0.41	7.8±0.35	7.8±0.56
Type (50%)	7.2±0.67	7.6±0.50	7.7±0.45	7.8±0.41	7.6±0.50
Dosa					
Control	7.2 ± 0.45	7 ± 0.51	7.7±0.45	7.6±0.48	7.4±0.50
Type (10%)	7.3±0.46	7.6±0.49	7.6±0.49	7.7±0.46	7.7±0.42
Type (20%)	7.8±0.63	7.6±0.50	7.8±0.56	7.8±0.35	7.6±0.61

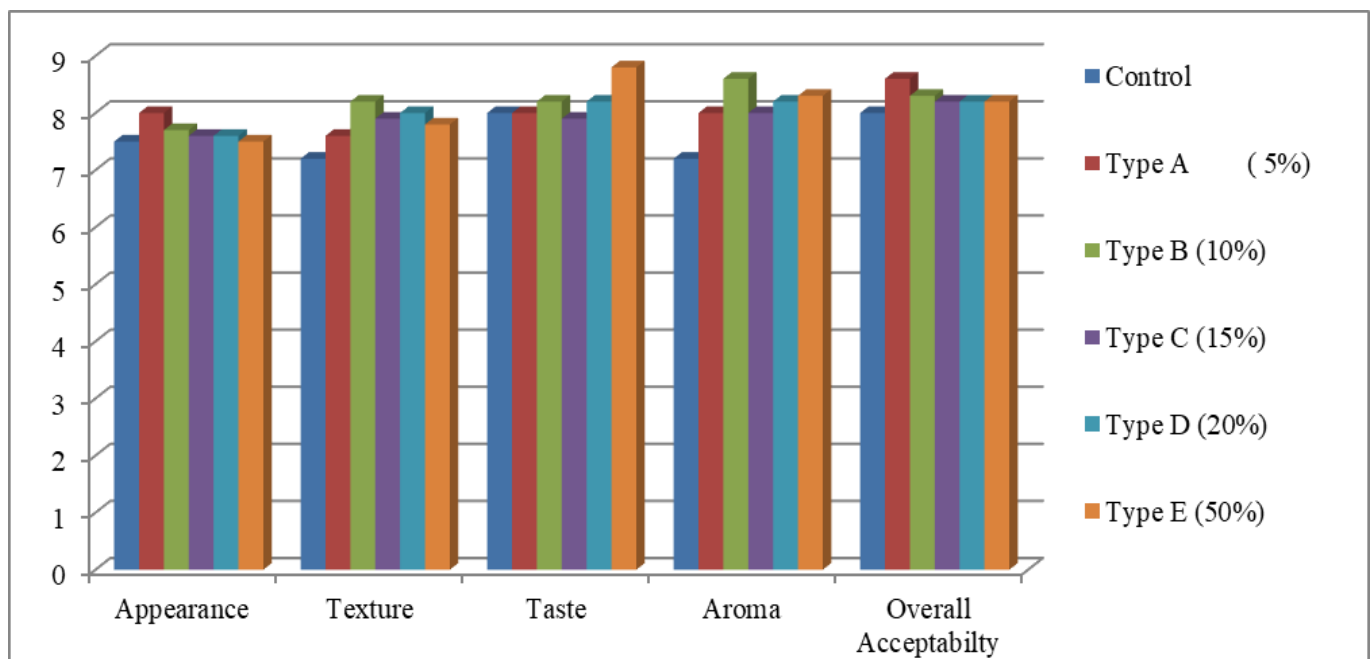


Fig 4: Sensory evaluation for cake incorporating by different level of RAGF

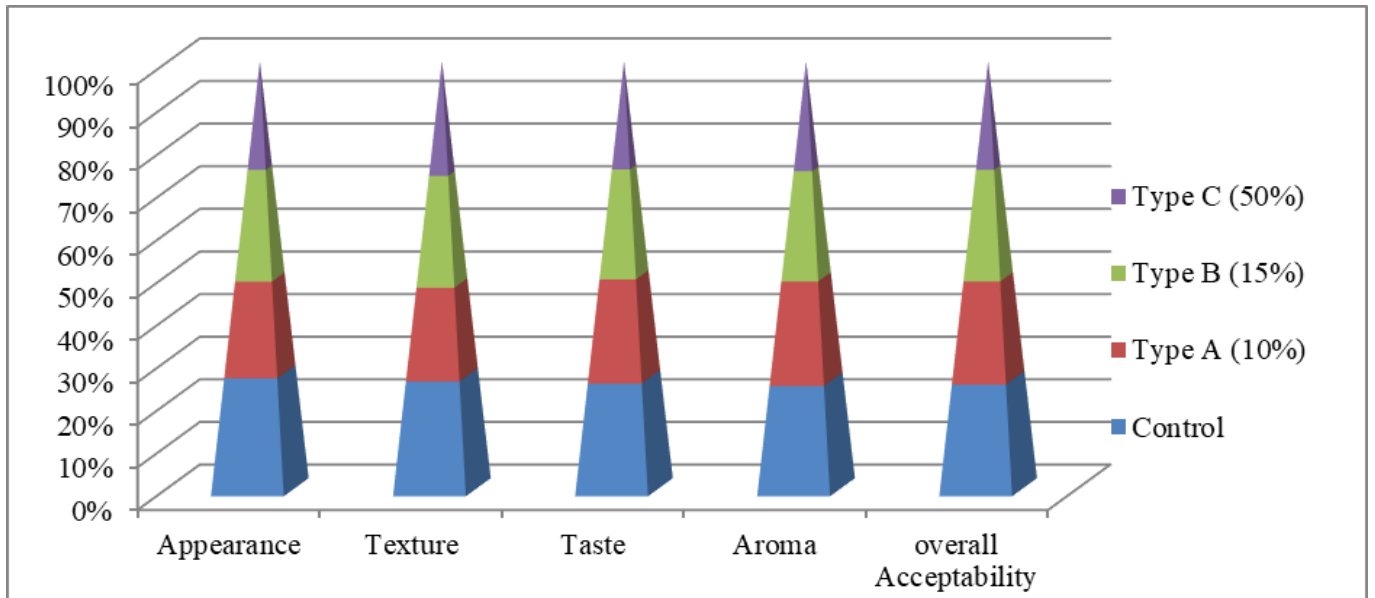


Fig 5: Sensory evaluation for Cashewnut burfi incorporating by PAGF at different level

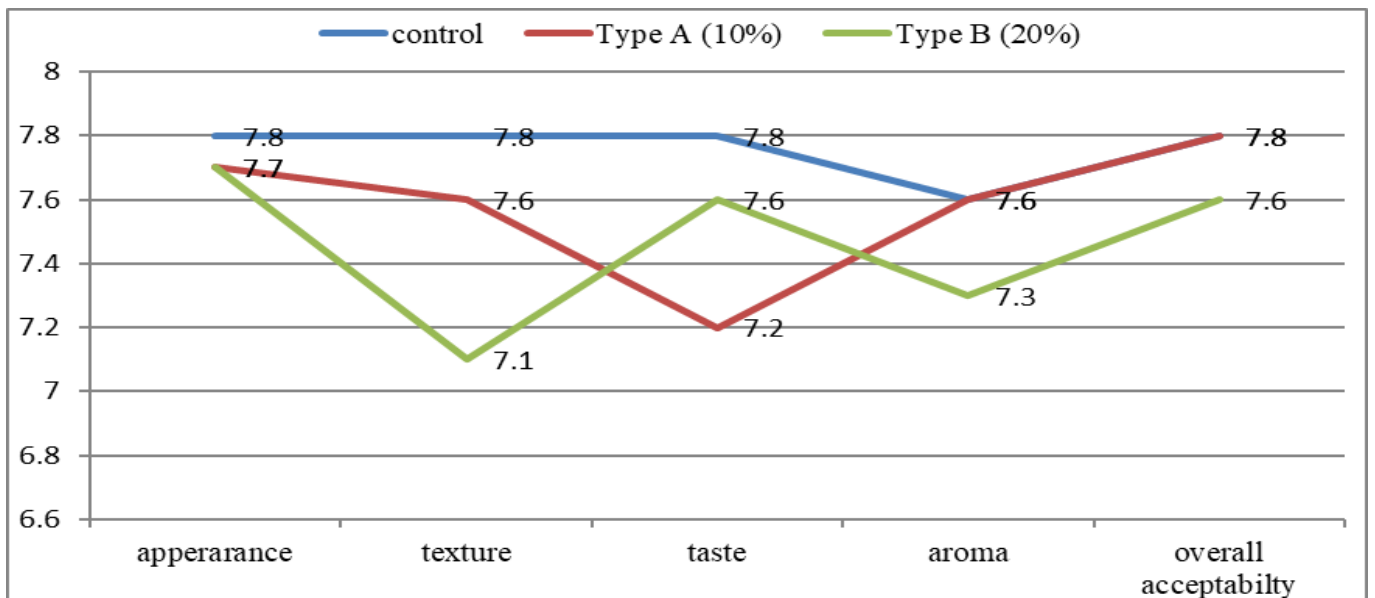


Fig 6: Sensory evaluation for coconut ladoo incorporating by PAGF at different level

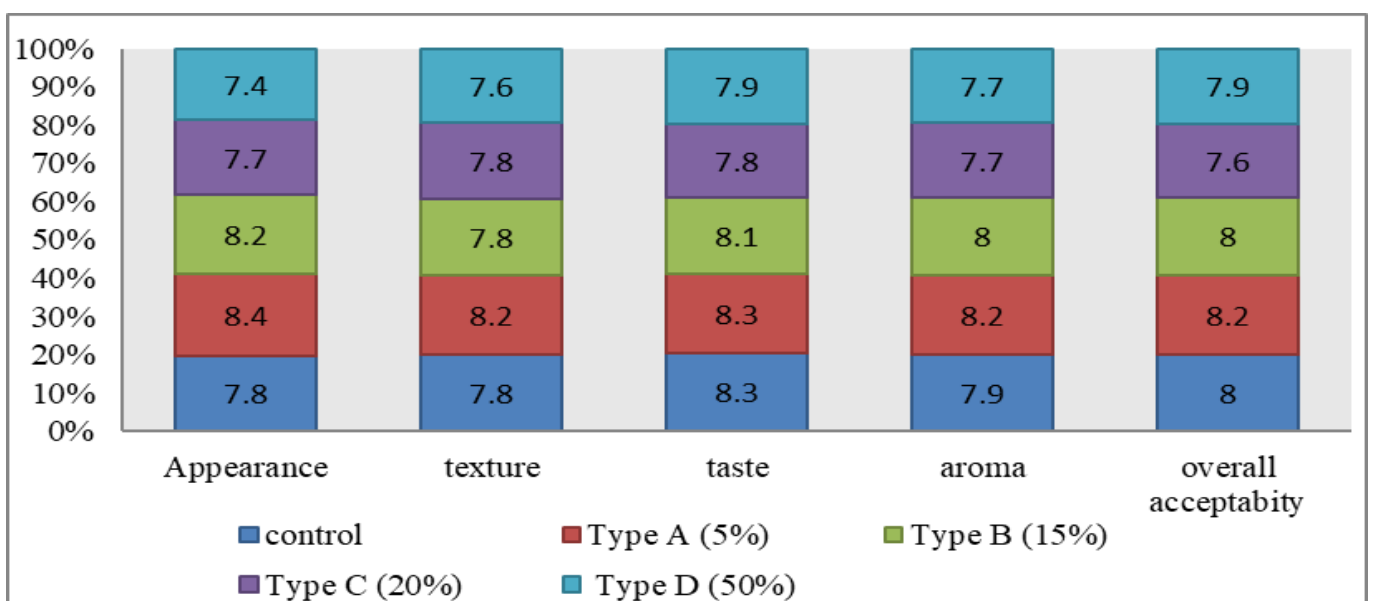


Fig 7: Sensory evaluation for besanburfi incorporating by PAGF at different level

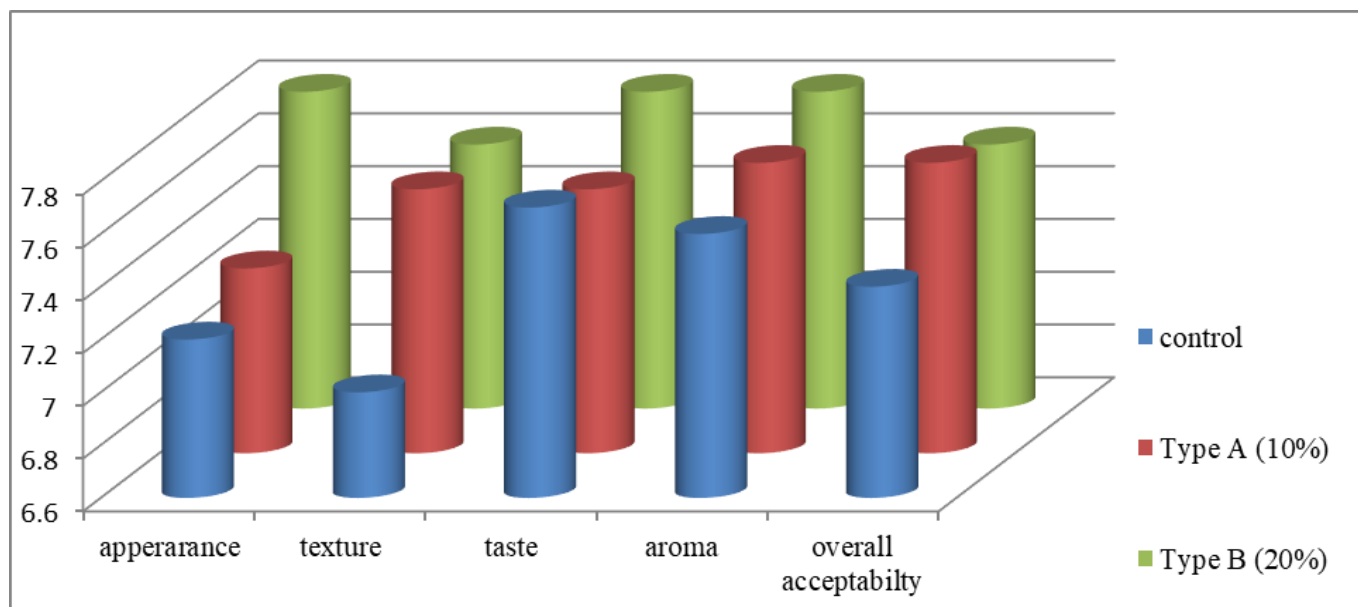


Fig 8: Sensory evaluation for dosa incorporating by soaked amaranth grain at different level

Fig 4. Shows the acceptability of cake incorporated RAGF. The highest means score for overall acceptability was Type A (5%) as compared to control and other types of cake. Clearly shows in fig 5 the highest acceptability of Cashewnut burfi was control and Type B and the lowest was Type C 50% incorporated PAGF. The highest overall acceptability of coconut ladoo in control and Type A were similar (7.8) and followed by type B (7.6) shown in fig 6. The most acceptable besan burfi was Type A (5%). Clearly shows in fig 7 all the types of besan burfi was acceptable for their sensory parameter. The highest acceptability of dosa incorporated SAG was Type A (7.7) and the lowest acceptability was control and followed by Type B shown in fig 8.

Conclusion

The present study gives information of about the utilization of amaranth grain flour in different products in roasted, popped and soaked form at various levels and its acceptability. The products formulate by using amaranth flour include cake, coconut ladoo, besan burfi, Cashewnut ladoo and dosa. The developed products were evaluated for sensory analysis by 30 semi trained panel using 9 points hedonic rating scale. Average mean scores of sensory parameter revealed that all the products were acceptable w.r.t their appearance, aroma, texture, taste and overall acceptability. Incorporation of amaranth grain flour in various products can be increase the popularity in order to improve nutritional parameter.

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