

Development of Value Added Amaranth Seed Laddus

Sanchita Guha

Freelance Dietitian

Abstract

Most known cereals have been the staple food of humans but these crops are not being able to fulfill the requirements on the aspects of nutrition as well as food security. The Food and Agriculture Organization (FAO) has identified amaranth as under-utilized crop but has immense potential to upgrade health, nutrition and global hunger. Amaranth seeds are rich in energy, protein, calcium and iron and it is fast and easily grown in difficult weather and soil conditions. This study aims to formulate nutritious sweet snack (laddu) by substituting different proportions of wheat flour/Bengal gram flour with roasted and grinded amaranth seeds for vulnerable groups. Sensory analysis is done with 20 semi-trained panelists on 9 point hedonic rating scale. All the products are well accepted.

Keywords: Amaranth, Nutritious, Substituting, Proportions, Sensory Analysis

Introduction

Traditional cereals like wheat, rice, corn are known to be the staple food of human population since long time. Unfortunately, these handfuls of cereals crops have become not only vitally important part of our diet, but have also become indispensable for our food security. However, these major cereals lack certain essential nutrients which needed to be either bio fortified or bio enriched. On the contrary, pseudocereals have these essential nutrients naturally in them and can grow in harsh climate with minimum agriculture facilities, but pseudocereals have been left neglected and unexplored for large scale production and consumption. So to bridge the gap of nutrient deficiencies and poverty, pseudocereals should be given considerable importance for improving health & nutrition and hidden hunger crisis and also livelihood of people.

Amaranth is such a high nutrition profile pseudocereal that is very traditional to India. It is one of the ancient and most commonly produced crops in India.

Amaranth, also known as Pigweed or Rajgira or Ramdana, is a group of more than 60 different species of grains from the family *Amaranthaceae* that have been cultivated for almost about 8,000 years. These grains were once considered a staple food in the Inca, Maya and Aztec civilizations [1,2,3]. Although amaranth is categorized as a grain, it's really a seed, a dicot seed (just like quinoa), hence Amaranth is considered a "pseudocereal".

Amaranth grains share characteristics of both a cereal and a leguminous seed from botanical and nutrient composition point of view as the protein content and the amino acid composition of these grains are somewhere between those of a cereal and a legume.

Therefore, it could be considered as a natural mixture of rice and beans nutritionally [4]. Cereals are known to have very low amounts of lysine but Amaranth protein has high lysine, tryptophan and

methionine [5,6]. The amount of protein present in amaranth grain has a superior amino-acid profile and is comparable to milk and egg. Amaranth also has high vitamin A, E, C and folic acid and mineral contents and a low level of anti-nutritional factors [7]. It also exhibits antioxidant properties as it contains polyphenols, anthocyanins, flavonoids and tocopherols [8]. It is also gluten – free and thus can be included in many restrictive diets like celiac disease [9,10].

Amaranth can be enjoyed in both sweet and savoury recipes. They have a sweet and nutty flavour and are a bit crunchy when cooked.

Table 1: Nutritive Value of Amaranth Seeds: (As per 100 gms of edible portions)[11]

Nutrients	Values
Energy	319 Kcal
Protein	14.7 gm
Fat	1.9 gm
Carbohydrate	60.7 gm
Crude Fibre	9.6 gm
Calcium	510 mg
Phosphorus	397 mg
Iron	11 mg

Health Benefits of Amaranth seeds

1. **Gluten Free** – Amaranth seed is a great alternative for persons with celiac disease and in gluten sensitivity cases.
2. **Reduces Inflammation**- Amaranth contains anti-inflammatory properties which reduce the body's production of immunoglobulin E, thus reducing pain and inflammation significantly!
3. **Lowers Cholesterol levels**- The oils and phytosterols in amaranth help lower LDL, Triglycerides while increasing “good” HDL cholesterol.
4. **Reduces the risk of developing cancer**- Amaranth is rich in peptides and anti-oxidants which provide protection against inflammation, thus preventing Cancer. It is especially high in phenolic acids like gallic acid, *p*-hydroxybenzoic acid and vanillic acid, all of which may help protect against diseases like heart disease and cancer.
5. **Healthy skin and Hair**- Amaranth contains Vitamin C, which is vital for skin, maintaining collagen and also reduces signs of ageing and increases lustre and shine to hair when consumed in diet regularly.

Objective

Based on the nutritional richness of the amaranth seeds, the current study has been undertaken to formulate a recipe with amaranth seeds blending with wheat flour/bengal gram flour and jaggery.

1. To prepare four types of nutritious sweet snack with amaranth seeds (laddu) for vulnerable groups.
2. To develop two types of laddus with different proportions of wheat flour and roasted amaranth seeds keeping the sweetness constant.

3. To develop two types of laddus with different proportions of bengal gram flour and roasted amaranth seeds keeping the sweetness constant.
4. To evaluate the prepared amaranth seed laddus by Sensory Evaluation Technique.

Methods and Materials

Procurement of raw material

Amaranth seeds, wheat flour, Bengal gram flour and sugar cane jaggery are procured from local market.

Recipes formulation

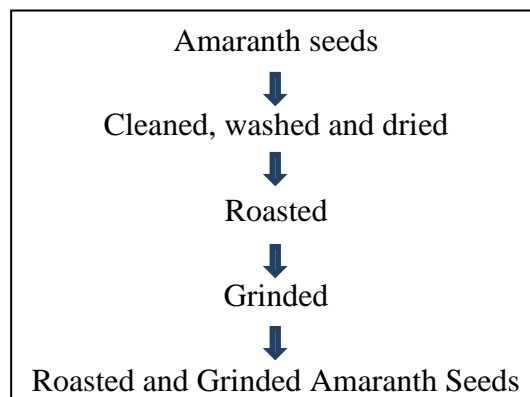
The four recipes are formulated based on common sweet dish – laddu with roasted amaranth seeds and different combinations of wheat flour / Bengal gram flour and jaggery. Two products are with amaranth seeds and wheat flour and two products are with amaranth seeds and Bengal gram flour.

Table.2: Amounts of amaranth seeds and flour

PRODUCT NO.	AMARANTH SEEDS	WHEAT FLOUR	BENGAL GRAM FLOUR	JAGGERY
Product 1	50 gm	50 gm	---	50 gm
Product 2	25 gm	75 gm	---	50 gm
Product 3	50 gm	---	50 gm	50 gm
Product 4	25 gm	---	50 gm	50 gm

Preparation of Laddus

1. Preparation of amaranth seeds



Flow Chart showing the processing of Amaranth seeds

2. Preparation of wheat and Bengal gram flour

Wheat flour and Bengal gram flour are also roasted till a light colour change.

3. Making of Laddus

Roasted and grinded amaranth seeds and Wheat flour/ Bengal gram flour are cooked with jaggery till a consistency where it can be made balls.

After cooking, the total amount of the cooked product came out to be 150 gm of which 5 laddus each weighing 30 gm were prepared.

Compilation of facts

A score card was organised to compile the facts and got the same filled by the members of the panel so that the product can be evaluated by them.

Product Evaluation

A panel of 20 members was created for the purpose of the study. The score card was filled after the sensory evaluation of the four products. This was a 9 point score card in which the form, colour, texture, taste, aroma and fullness of the products were evaluated.

Selection of Panelists

The products are assessed for their sensory characteristics by a panel of twenty semi trained judges from the faculty members of Jamshedpur Women’s University.

The quality and taste of all the four products are checked by the evaluation score card - nine point Hedonic rating scale.

Score Card organization

Table 3: Score Card Organization

PRODUCT NO.	DISLIKE EXTREMELY 1	DISLIKE VERY MUCH 2	DISLIKE MODERATELY 3	DISLIKE SLIGHTLY 4	NITHER LIKE NOR DISLIKE 5	LIKE SLIGHTLY 6	LIKE MODERATELY 7	LIKE VERY MUCH 8	LIKE EXTREMELY 9

Observation and Analysis

The product are analysed on the basis of form, colour, texture, taste, aroma and over acceptability and then the products are sensory evaluated. The statistical tool used for analysing the above sensory evaluation factors are frequency and percentage.

Resultand Discussion

Product 1: Laddu made of 50 gm atta, 50 gm amaranth seeds and jaggery

Table 4: Sensory Analysis of product 1

Serial No.	Product Analysis	1		2		3		4		5		6		7		8		9	
		F	%	F	%	F	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Form	0	0	0	0	0	0	0	0	0	0	4	20	2	10	10	50	4	20
2	Colour	0	0	0	0	0	0	0	0	0	0	4	20	10	50	6	30	0	0
3	Texture	0	0	0	0	0	0	0	0	0	0	0	0	4	20	6	30	10	50
4	Taste	0	0	0	0	0	0	0	0	10	50	0	0	4	20	2	10	4	20
5	Aroma	0	0	0	0	0	0	0	0	0	0	0	0	4	20	6	30	10	50
6	Overall Acceptability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	50	10	50

As depicted in the above table 4, the data is as follows:

On account of form, 20% of the panel members liked extremely, 50% liked very much, 10% liked moderately and 20% liked slightly.

On the parameter of colour, 30% liked very much, 50% liked moderately and 20% liked slightly.

For texture 50% liked extremely, 30% liked very much and 20% liked moderately.

20% liked extremely, 10% liked very much, 20% liked moderately and 50% neither liked or disliked the taste.

Considering aroma of the product, 50% liked extremely, 30% liked very much and 20% liked moderately.

Taking into account of the Overall Acceptability, 50% liked extremely and 50% liked very much.

Product 2: Laddu made of 75 gm atta, 25 gm Amaranth seeds and Jaggery

Table 5: Sensory Analysis of product 2

Serial No.	Product Analysis	1		2		3		4		5		6		7		8		9	
		F	%	F	%	F	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Form	0	0	0	0	0	0	0	0	0	0	6	30	6	30	4	20	4	20
2	Colour	0	0	0	0	0	4	20	0	0	0	6	30	6	30	4	20	0	0
3	Texture	0	0	0	0	0	0	0	0	0	0	4	20	4	20	6	30	6	30
4	Taste	0	0	0	0	0	0	0	0	0	0	0	0	6	30	8	40	6	30
5	Aroma	0	0	0	0	0	0	0	0	0	0	6	30	4	20	4	20	4	30
6	Overall Acceptability	0	0	0	0	0	0	0	0	0	0	0	0	6	30	10	50	4	20

Similarly, for product no. 2, above table 5 reveals that:

On the parameter of form 30% of the panel members have liked slightly, moderately liked is 30%, 20% liked very much and 20% liked extremely.

Considering colour, percentage of panel members liked slightly and liked moderately is 30 respectively and liked very much is 20.

On account of texture, 20% have liked slightly and liked moderately respectively, 30% have liked very much and 30% have liked extremely.

Regarding taste, percentage of panel members liked moderately is 30, liked very much is 40 and liked extremely is 30.

For aroma also, 30% have slightly liked, 20% have liked moderately, 20% liked very much and 30% liked extremely.

Taking account of overall acceptability, 30% have liked moderately, 50% liked very much and 20% liked extremely.

Product 3: Laddu made of 50 gm Besan, 50 gm Amaranth seeds and Jaggery

Table 6: Sensory Analysis of product 3

Serial No.	Product Analysis	1		2		3		4		5		6		7		8		9	
		F	%	f	%	F	%	f	%	f	%	F	%	f	%	f	%	f	%
1	Form	0	0	0	0	0	0	2	10	0	0	4	20	4	20	4	20	6	30
2	Colour	0	0	0	0	0	0	0	0	4	20	4	20	2	10	4	20	6	30
3	Texture	0	0	0	0	0	0	0	0	0	0	0	0	6	30	10	50	4	20
4	Taste	0	0	0	0	0	0	0	0	0	0	6	30	0	0	8	40	6	30
5	Aroma	0	0	0	0	0	0	0	0	0	0	0	0	6	30	10	50	4	20
6	Overall Acceptability	0	0	0	0	0	0	0	0	0	0	0	0	8	40	4	20	8	40

The data in above table 6 can be summarised as follows:

On account of form, 30% of the panel members liked extremely, 20% liked very much, 20% liked moderately and 20% liked slightly.

On the parameter of colour, 30% liked extremely, 20% liked very much, 20% liked moderately and 20% liked slightly.

For texture 20% liked extremely, 50% liked very much and 30% liked moderately.

30% of the panel members liked extremely, 40% liked very much and 30% liked slightly taste of the product.

Considering aroma of the product, 20% liked extremely, 50% liked very much and 30% liked moderately.

Taking into account of the Overall Acceptability, 40% liked extremely, 20% liked very much and 40% have moderately liked.

Product 4: Laddu made of 75 gm Besan, 25 gm Amaranth seeds and Jaggery

Table 7: Sensory Analysis of product 4

Serial No.	Product Analysis	1		2		3		4		5		6		7		8		9	
		F	%	F	%	F	%	f	%	f	%	F	%	f	%	F	%	F	%
1	Form	0	0	0	0	0	0	0	0	0	0	4	20	6	30	4	20	6	30
2	Colour	0	0	0	0	0	0	0	0	0	0	0	0	6	30	4	20	10	50
3	Texture	0	0	0	0	0	0	0	0	0	0	4	20	4	20	6	30	6	30
4	Taste	0	0	0	0	0	0	0	0	0	0	6	30	4	20	4	20	6	30
5	Aroma	0	0	0	0	0	0	0	0	0	0	6	30	4	20	6	30	4	20
6	Overall Acceptability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	50	10	50

Similarly, for product no. 4, the table 7 reveals as follows:

On the parameter of form 20% of the panel members have liked slightly, moderately liked is 30%, 20% liked very much and 30% liked extremely.

Considering colour, percentage of panel members liked moderately is 30 respectively, liked very much is 20 and liked extremely is 50.

On account of texture, 20% have liked slightly and liked moderately respectively, 30% have liked very much and 30% have liked extremely.

Regarding taste, percentage of panel members liked slightly is 30, liked moderately is 20, liked very much is 20 and liked extremely is 30.

For aroma also, 30% have slightly liked, 20% have liked moderately, 30% liked very much and 20% liked extremely.

Taking account of overall acceptability 50% liked very much and 50% liked extremely.

Table 8: Nutritive value of Products (values are of uncooked foods)

PRODUCT NO.	ENERGY (Kcal)	PROTEIN (gm)	FAT (gm)	CARBOHYDRATE (gm)	CALCIUM (mg)	IRON (mg)
Product 1	524	13.6	1.85	113.45	319	9.3
Product 2	527	13	1.7	114.7	203	7.7
Product 3	537	18	3.8	107.7	323	9.5
Product 4	550	19.5	4.7	107.5	209.5	8

From the table 8, it is concluded that the average energy of all the products is 535. The average protein content is 16, carbohydrate is 111. Similarly, the average of calcium and iron content are 263 and 8.6 respectively.

Major Findings

- On account of form, panelists preferred product 1.
- On the parameter of colour, most preferred is product 4.
- For texture, again product 1 is most liked.
- Product 2 and 4 both are liked for taste.
- Again product 1 wins the race when considered aroma.
- In overall Acceptability, product 1 and 4 are most preferred by the panel members.

Laddus are formulated by substituting wheat flour/bengal gram flour with different proportions of roasted and grinded amaranth seeds. The sensory analysis exhibits that product 1 and 4 have the highest sensory appeal followed by 2 and 3, however all the products are well accepted. Chungkhum and Singh (2021)[12] developed prepare different products like cakes, besan burfi, coconut laddoo, cashewnut burfi, and dosa by incorporating different proportions of amaranth grain flour with wheat flour/ Bengal gram flour. Results showed these products were acceptable after sensory analysis and can also enhance the nutritional values. Amaranth is suited for mixing with other flours as it has no strong taste and flavour

[13].Kowsalya and Indra (2010)[14] revealed that development of extruded products from amaranthus incorporated nutritious mix were highly acceptable from the sensory evaluation.

Protein, Calcium and iron content are in more in products 1 and 3 where amaranth substitution is more. Emire and Arega (2012) [15] studied about making bread from combining amaranth grain flour and wheat flour in different formulations. Their study on parameter of quality and sensory aspect revealed that there is a significant increase in protein, fat, iron, zinc, phosphorus and calcium contents if there is an increase in amaranth substitution and an improved sensory characteristics. Zebdewos et al. (2015)[16] unveiled that iron content is boosted by adding amaranth and phytate levels are lowered.

Requirement of energy, protein, calcium and iron is increased during pregnancy and lactation and in children of growing age [17]. This laddu with its high nutrient profile and good sensory acceptance can make a better midmeal snack for the vulnerable groups.

Conclusion

This study was conducted to investigate the potential of using Amaranth seed as an important substitution to our regular staple food. Four different types of laddus (designated as Product 1 to 4), having different proportion of Amaranth seed and wheat / Bengal Gram flour was tested for different sensory parameters. All the products are well accepted. The study also shows that nutrients like protein, calcium and iron as well as calorie content increase with the increase in percentage of amaranth seeds in the laddu. So these laddus can be recommended as a nutrient dense snack for pregnant and lactating mothers, growing children and also to patients who require high calorie and high protein. It can benefit supplementary nutrition programs of ICDS and Midday meal for its high nutrient profile and low cost (Rs 10/serving of 5 laddus). It is very easy and takes very less time to prepare.

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