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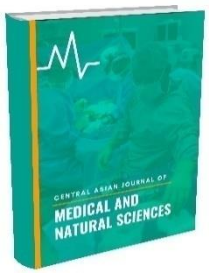

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Value Addition and Process Standardization of Nutri-Rich Ragi (Eleusine Corocana) Products

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Abstract: Finger millet is in food use since time immemorial and large number of traditional food preparations is in practice in the rural areas (predominantly tribal areas), particularly in the production catchments. Finger millet also known as ragi in India is one of the important cereals occupies highest area under cultivation among the small millets. Finger millet is comparable to rice with regard to protein (6-8%) and fat (1-2%) and is superior to rice and wheat with respect to mineral and micronutrient contents. It is a major source of dietary carbohydrates for a large section of society. However, its utilization in the daily dietary at present is largely restricted to rural areas/tribal areas only. Unavailability of products to the taste of urban community is the main reason. Processing the finger millet using traditional as well as modern techniques for the development of value added and convenient food products would be the possible solution for its promotion and enhancement of consumption, nutritional status and thereby increasing profitability and better livelihood to the tribal community. In present investigation, Ragi laddoo, Ragi Halwa and Weaning food were prepared from it by mixing other cereals in definite proportions. Several packaging materials were used of which Low density polyethylene pouch was found to be the best packaging material as compared to other packaging materials for storage of instant mixes (halwa mix and weaning food mix) up to 90 days. Polypropylene pouches for storage of ragi formulated laddoo were found to be the best as compared to other packaging materials up to 90 days at ambient condition without any nutritional losses.

Key words: Finger millet, Processing and Value addition.

Introduction

Of the estimated total of 80000 plants with possible economic use, approximately 30,000 plants have been found edible in nature, and 7,000 have been cultivated by the mankind at one time or the other; but out of these, only 158 plants are used widely for food. Among these, 30 crops provide 90% of world's food, 10 supply 75% of world's food basket; and over 60% of world's total protein and calories are provided by only three crops – rice, wheat and maize. Our food security, with such a high dependence on these narrow food-base, faces and will face high risk owing to growing uncertainties in the climate and emergence of new biotic and abiotic stresses. Consequently, there is a global concern to collect, introduce, evaluate and utilize vast array of lesser known, under-exploited, alternative crop-plants for diversifying agricultural systems.

India is the leading producer of small millets namely, finger millet (*ragi*), kodo millet (*kodo*), foxtail millet (*kangni*), barnyard millet (*sawan*), proso millet (*cheema*) and little millet (*kutki*). Annual planting area under them is around 2.5 million hectares; and nearly 1.5 million hectares is under finger millet comprising about 40-50% of crop's global area. During the last three decades, area under finger millet has declined but with the significant improvement in the productivity (1,500 kg/ha), its annual production is maintained at around 2.4 million tonnes. At present, small millets account for less than 1% of food grains produced in the world (ICAR, 2010). Their cultivation dates back to nearly 5000 years, and in India, they form an important component of the traditional cropping systems and contribute significantly to the regional food and nutritional security and diversity in the national food basket; and they are important in areas of their production as dryland crops, as well as for hill agriculture. The small millet grains have longer storage life, and can be termed as famine reserve. The resilience exhibited by them may prove good for their adjustment to different eco-systems and make them potential crops for contingency plantings.

Ragi or finger millet (*Eleusine coracana*) is important millet grown extensively in various regions of India and Africa, constitutes as a staple food for a large segment of the population in these countries (Majumder et al.,2006).Nutritionally, its importance is well recognized because of its high content of calcium (0.38%), dietary fiber (18%) and phenolic compounds (0.3–3%). The iodine content is said to be highest among all the food grains. Ragi has best quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *etal.,* 2004). Thus ragi is a good source of diet for growing children, expecting women's, old age people and patients. Ragi is considered to be ideal food for diabetic individuals also due to its low sugar content and slow release of glucose/sugar in the body(Kang et al., 2008 and Lakshmi & Sumathi, 2002). Ragi has considerable versatility and could be used for the preparation of traditional and contemporary food. The relatively newer food products which are currently being explored are vermicelli, laddu and papad which are prepared either out of ragi alone or in combination with refined wheat flour, soy flour, oats, jaggery etc. Processing them using traditional as well as contemporary methods for preparation of value added and convenience products would certainly diversify their food uses. Halwa refers to many types of dense, sweet confections. It is a type of dessert with the consistency of a very thick. It is generally prepared from various raw materials like fine suji (semolina) from wheat, mung dhal, chickpea. Moreover, the halwa is normally rich in fat and sugar, but not satisfactory in other nutrients. Millet malt is used as a cereal base for low dietary bulk and calorie dense weaning foods, supplementary foods, health foods and also amylase rich foods. Malting helps to increase significantly the nutrient composition, fiber, crude fat, vitamins B, C and their availability, minerals (Sangita &Srivastava, 2000), improve the bioavailability of nutrients, sensory attributes of the grains. Laddoo is a ready to eat traditional sweet snack, its main ingredients include popped grains, canesugar or jaggery (gud) and liquid glucose. The cereals or pulses alone or mix based product are generally inferior in nutritional quality so it was thought to develop a nutritious mix for development of various traditional products which have more

superior quality. Processing them using traditional as well as contemporary methods for preparation of value added and convenience products would certainly diversify their food uses. Their exploitation for preparation of ready-to-use or ready-to-cook products would help in increasing the consumption of millets among non-millet consumers and thereby nutritional security. The present paper is an attempt to describe some basic information about finger millet, the processing requirement and some avenue for its value addition and food uses.

MATERIALS AND METHODS

The present investigations were carried out in the Department of Food Processing and Agricultural Engineering Department IGKV, Raipur. Ragi puff was prepared by the method as described by Malleshi and Desikachar (1981) and Laddoo as prepared by heating jaggery to a desired consistency, cooling it and mixing it with Ragi puff. After mixing it was casted as roll, allowed to cool and packed for shelf life evaluation. Malleshi, (2007) reported that the malt flour is a good source of amylases and it is a substitute to malt dextrin and can be blended with milk and spray dried to prepare weaning food. Halwa mix was prepared to study the organoleptic quality and shelf life by selecting appropriate packaging material The sensory quality characteristics of the prepared products such as color, taste, texture, flavor and overall acceptability were evaluated by panel of judges on nine point hedonic scale as described by Amerine et al. (1965).The shelf-life studies were carried out in aluminum foil, polypropylene and low density polyethylene pouches for a period of 3 months at ambient conditions 500gm of each sample instant mixes were packed and kept at room temperature for 90 days. All samples were drawn periodically after 0, 30, 60, 90, days and subjected to product development and there sensory evaluation.

RESULTS AND DISCUSSION

The present investigation on to study the organoleptic quality and storability using different packaging materials of the products developed from nutri-rich ragi *(Eleusine corocana*)" were carried out with the objectives to develop products with high nutritional quality having good acceptability and storability. The obtained results have been presented as under Organoleptic properties of nutri-rich ragi based developed products. Different type of nutri-rich ragi based products were developed from ragi, fortified with wheat, sorghum soybean, green gram, kutki and amaranth and subjected to sensory test on 9 point hedonic scale. From the sensory mean score and the comments of the panelists, best combination were selected C4 (50wheat+ 30ragi+10sorghum+10soybean) formulated ragi halwa, W2 formulated weaning food (70 ragi + 10 kutki + 20 greengram) and Ch2 nutri-rich ragi formulated laddoo (45Ragi:25amaranth:30Jaggery). **Sensory analysis of ragi based Halwa :** The results of sensory analysis of nutri-rich ragi based halwa, made from ragi, wheat, sorghum and soybean flour in the different ratio are given in table below.

Table-1: Formulation of composite flour from different food grains in various combinations given in table

Treatment	Wheat (g)	Ragi (g)	Sorghum (g)	Soybean (g)
Control	100	-	-	-
C1	80	5	10	5
C2	70	10	10	10
C3	60	20	10	10
C4	50	30	10	10

Table-2: Different combination for preparation of weaning food.

Treatment	Ragi (g)	Kutki (g)	Green gram(g)
Control	100	-	-
C1	80	5	15
C2	70	10	20
C3	60	15	25
C4	50	20	30

Table-3: Formulation of nutri-rich puffed ragi based laddoo.

Treatment	Puffed Ragi (g)	Puffed amaranth (g)	Puffed jaggery (g)
Control	70	-	30
C1	35	35	30
C2	40	30	30
C3	45	25	30
C4	50	20	30

Table-4: Sensory score of ragi based halwa.

Treatment	Colour	Texture	Taste	Flavor	Overall acceptability
C0	8.5	8.0	8.0	8.0	8.0
C1	8.0	8.0	7.5	7.0	7.5
C2	7.5	7.0	7.0	7.0	7.0
C3	7.5	7.0	7.0	8.0	7.5
C4	7.0	7.5	8.5	8.5	8.5
SEM±	0.18	0.18	0.23	0.27	0.30
CD at 5%	0.58	0.57	0.74	0.85	0.70

Table-5: Sensory score of ragi based weaning food.

Treatment	Colour	Texture	Taste	Flavor	Overall acceptability
W0	8.5	8.0	8.0	8.0	8.0
W1	8.0	8.0	7.5	7.0	7.5
W2	7.5	7.0	7.0	7.0	7.0
W3	7.5	7.0	7.0	8.0	7.5
W4	7.0	7.5	8.5	8.5	8.5
SEM±	0.18	0.18	0.23	0.27	0.30
CD at 5%	0.58	0.57	0.74	0.85	0.70

Result revealed that C4 (50wheat +30ragi+10sorghum+ 10soybean) formulated halwa mix was accepted as best in taste, flavor and overall acceptability but the color was slight darker than other prepared halwa due to increased level of ragi, but the texture and flavor were good. It was found same as of itagi *et al.*,(2013).Halwa mix stored in LDPE was good acceptability as compared to others packaging material. Similar result has been reported by Itagi *et al.*, (2013). Sensory analysis of nutri-rich ragi based weaning food**.** The results of sensory of analysis of nutri-rich weaning food made from different combination of ragi, green gram and kutki are given in table.

Table-6: Sensory score of nutri-rich ragi laddoo

Treatment	**Colour**	**Texture**	**Taste**	**Flavor**	**Overall acceptability**
Ch0	8.5	8.0	8.0	8.0	8.0
Ch1	8.0	8.0	7.5	7.0	7.5
Ch2	7.5	7.0	7.0	7.0	7.0
Ch3	7.5	7.0	7.0	8.0	7.5
Ch4	7.0	7.5	8.5	8.5	8.5
SEM±	0.18	0.18	0.23	0.27	0.30
CD at 5%	0.58	0.57	0.74	0.85	0.70

Table-7: Effect of storability on the overall acceptability of developed ragi based products.

Treatment	**Packaging material**	**Storage period in days**				**SE M**	CD at 5%
		0	**30**	**60**	**90**		
Halwa	**Polypropylene Pouch**	8.5	7.0	7.07	6.94	0.10	0.27
	Low density Polypropylene pouch	8.5	8.00	7.97	7.25	0.07	0.20
	Laminated Alluminium pouch	8.5	8.25	7.50	7.00	0.08	0.23
Weaning food	**Polypropylene Pouch**	8.5	8.25	8.20	7.38	0.14	0.41
	Low density Polypropylene pouch	8.5	8.18	8.19	7.32	0.13	0.38
	Laminated Alluminium pouch	8.5	8.40	8.11	7.30	0.09	0.27
Laddoo	**Polypropylene Pouch**	8.5	8.00	7.79	7.35	0.07	0.20
	Low density Polypropylene pouch	8.5	8.25	7.45	7.25	0.08	0.23
	Laminated Alluminium pouch	8.5	8.41	8.11	7.00	0.09	0.27

Ragi malt, Kutki malt & Green gram malt based weaning food in proportion of 70:20:10 respectively was best in taste and flavor. Similar finding have been found by Malleshi and Desikachar (1981) formulation and development of weaning foods. Storability of this formulation was found best in polypropylene pouch for period of 3 months. Similar result was reported by malleshi *et al.*, (1989). The results of sensory analysis of nutri-rich ragi laddoo, made from puffed ragi, amaranth and jaggery in the different ratio are given in table 7.

Laddoo prepared from puffed ragi (45) and amaranth (25) was very well accepted due to good taste, and flavor obtained puffing of ragi and amaranth grains. Laddoo prepared as ragi base ingredient was of good acceptable characteristics. This result is supported by Shukla *et al.*(1986).The overall acceptability of Laddoo was better in polypropylene pouch as compared to other packaging materials during storage period and similar findings were reported by Chaturvedi and Shrivastava (2008) forpopped grain of finger millet. Effect of storability on the overall acceptability of developed ragi based products **:** Mean score values of overall acceptability of all the ragi based products prepared and stored for shelf live and packing material evaluation has been presented in table 4.The halwa prepared from ragi based halwa mix was kept in 3 different packing materials of which one stored in low density polyethylene was found good and its overall acceptability at the end of storage period was also desirable. Similarly analyzing, of all the formulated weaning food mix, one stored in polypropylene were good with its overall acceptability being palatable at the end of storage period. The Nutri-rich

laddoo prepared and stored in polypropylene pouches were found good on overall acceptability during overall storage period.

CONCLUSION

Finger millet is well comparable and even superior to many cereals in terms of mineral and micronutrient contents. Its major use as food has remained only in the area where it is cultivated and to the traditional preparations. Finger millet has good potential of providing nutritional security to the consumers. Its consumption in urban area can be increased through its proper processing and value addition. With the advancement of post harvest processing and value addition technologies, it has become possible to process and prepare value added products which are acceptable by both rural and urban consumers. This will not only help in increasing the profitability of its cultivators but will also help in providing income and employment opportunities in rural area.

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