Original Article

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Evaluation of Antioxidant Capacity and Nutritional Composition of Millet Based Low Cost Weaning Food Formulation

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Abstract

Weaning food must be supplied by the age of six months to fulfill the nutritional need of infant. Generally, the weaning foods available in market are prepared by using cereals and are costly. Although millets are equally nutritious, their use is avoided. The research work was planned to formulate millet based weaning food using finger millet, pearl millet and soybean. Different formulations were developed and evaluated sensorily. Formulation with the highest sensory score was considered as experimental formulation (EF) and evaluated for its antioxidant capacity and nutritional content. The EF was prepared by using Pearl millet: Finger millet: Soybean in the ratio of 30:35:35 with powdered Sugar (40%) and Milk Powder (10%). That possessed 13.81 ABTS, 48.83 DPPH and 53.76 FRAP antioxidant capacity. That also contained 13.52g% protein, 6.75g% fat, 2.53g% ash, 1.50g% fiber, 48.34g% carbohydrate, 227.57mg% calcium, 2.77mg% iron and 38.73mg% vitamin-C. It found better in all three types of antioxidant capacity as compared to control thus more beneficial for overall health maintenance. It was also superior in two principal nutrients required for growth and development of infants i.e. protein (17.56%) and fat (44.23%) and two important minerals i.e. calcium (21.66%) and Iron (30.05%) necessary for their bone and blood development, respectively as compared to control. The total antioxidant activities for all the three ABTS, DPPH and FRAP were found higher as compared to control. To meet the nutritional need of infants, 100g of supplementary mix is recommended daily coasting just 5 Rs. The product can be stored for 4 months under ambient condition. Thus a homemade, nutritionally balanced low coast weaning food could be formulated.

Keywords: Weaning Food; Infancy; Millets; Finger Millet; Peral Millet; Soybean.

Introduction

Infancy is period of rapid growth. Weaning food is recommended for the overall growth and complete development after 6 months.

In India, it has been observed that infants do not served special foods. Food which is prepared for other members, same food is served to infant just after altering consistency. In urban areas where mothers are aware, baby food is fed to the infants but are quite expensive. Most of these weaning foods are prepared by using cereals.

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However, millets are ignored in the formulation of weaning food mix. Though that are unique among the cereals because of their richness in calcium, dietary fibre, polyphenols and protein [6], fat, essential amino acids particularly methionine and cysteine [12]. It is well known fact that cereals and millets possess many antinutritional factors which can be reduced by applying various processing techniques. Studies have revealed that germination enhances the nutritive value of cereals and legumes [9, 10, 7] and decrease the levels of antinutrients present in cereals [11].

In the present study finger millet, pearl millet and soybean were used to develop weaning food mix. Finger millet contains high levels of calcium, iron and manganese, its protein is relatively better balanced; it contains more lysine, threonine and valine than other millets. Its carbohydrate, protein, fiber and mineral content are comparable to cereal. Nutritionally pearl millet is comparable and even superior to major cereals with respect of energy value, protein, fat and

minerals. It makes an important contribution to human diet due to high levels of calcium, iron, zinc, lipids and high quality proteins. Besides this, millets are rich source of phytochemicals such as phinolics, âglucan, lignans, phytates sterols, tocopherols, dietary fibers and carotenoids, which act as an antioxidants and boost our immune system [6,8,5]. Soybean stands first to supply both quantity and quality of the protein.

Antioxidants are natural substances found in foods that neutralizes the free radicals and can reduces incidence of disease such as cancer, heart disease and health risk related to aging. The millets and soybean are rich source of antioxidant activity. Various antioxidant activity methods have been used to monitor and compare the antioxidant activity of foods.

Objectives

i. To formulate low coast weaning food by mixing Pearl millet, Finger millet and Soybean.
ii. To standardize the formula using sensory evaluation technique.
iii. To estimate the antioxidant activity and nutritional composition of formulated weaning food.

Methodology

The study was conducted into four parts, process treatment to grain seed, formula optimization to select the best weaning food mix among the various combinations of grains and evaluate the antioxidant capacity and nutritional composition of the selected weaning food mix to judge its possible use in the infant diet. A coast was calculated, dietary recommendations were estimated and a shelf life was also studied as separate part of this long study.

Grain Processing

Both the millets were germinated and soybean was pressure cooked and dehulled before milled to fine dry powder. The process parameters were standardized for soaking, germination, pressure cooking and drying based on laboratory trials conducted based on literature.

Formula Optimization

Formula optimization was carried out by mixing processed powder of White Finger millet, Pearl millet and Soybean. Combination was made in such a way that, the quantity of any one ingredient ranged from 10 to 50 percent (at an interval of 10 percent) and rest two ingredients in equal quantity to make 100 percent. Thus total fifteen combinations of weaning food formulations were prepared into three phases. In each combination 10 percent milk powder and 40 percent powdered sugar were added.

Before serving, 25 g of weaning food mix was added in 150ml of water and cooked for 3 minutes after getting boiled and served immediately to the semi trained panel of 7 judges into 3 replications for sensory evaluation using 9 point Hedonic rating scale. From each phase one highly accepted mix was selected and further sensory and nutritional analysis were carried out. The formulation scored sensorily the heights, considered as experimental formulation and used for the further experimentation.

Nutritional Evaluation

Highly accepted three mixes were analyzed in triplicate for proximate composition [1]. Total carbohydrate was calculated by difference and energy content was calculated by factorial method. Irons, calcium, crude fiber, ash were analyzed by [2] method. Protein was analyzed by Kjeldahl method while fat content by solvent extraction method.

Antioxidant Activity Evaluation

Various antioxidant activity methods have been used to monitor and compare the antioxidant activity of foods. In the present experiments, three methods of analyzing total antioxidant capacity are used.

i. 2,2 Azinobis, 3 Ethyl Benzothiazolin-6-Sulphonic Acid , radical scavenging activity (ABTS RSA) [13].
ii. 2,2-diphenyl-1-picrylhydrazyl, radical scavenging activity (DPPH RSA) [4].
iii. Ferric reducing antioxidant power assay (FRAP assay) [3].

Data Analysis

The standard SPSS programme was run to analyses the data on mean, SEM, CV, CD. All the data was tested for significance using the ANOVA / Ducncan's test [14].

Results and Discussion

Results obtained are presented into two subheadings,

formula optimization and analysis of nutritional composition. Results on coast calculation, shelf life study and dietary recommendations are also mentioned at the last in nutshell from the other part of this long study.

Grain Processing

Both the millets were germinated and soybean was pressure cooked and dehulled before milled to fine dry powder. The standardized processing illustrated in figure 1.

Formula Optimization

The best accepted combination from each phase found is listed in Table 1. Among that combinations formula for phase III (Pearl millet:Finger millet:Soybean in the ratio of 30:35:35) scored the highest in all the sensory attributes. Thus it was selected as an experimental formulation.

Nutritional Composition

The *protein* content for phase II formulation was found the highest followed by Phase III and both were significant. However, both were significantly differ from Phase I formulation and control. The experimentally selected mix contains 17.56% more protein as compared to control. That is beneficial for the infants for their rapid growth.

The *fat* content was increased significantly in all the three formulations as compared to control. The rise was found slightly less than half. Thus the developed formulation beneficial for infants as they required more energy per unit of weight as compared to adults for their constant activity.

Carbohydrate was increased for Phase I and III formulations while decreased in Phase II mixes as compared to control. However the difference was just 5 g%. *Ash and Fiber* content was decreased significantly at 25.14% and 32.00%, respectively.

Calcium and Iron, the most important minerals for

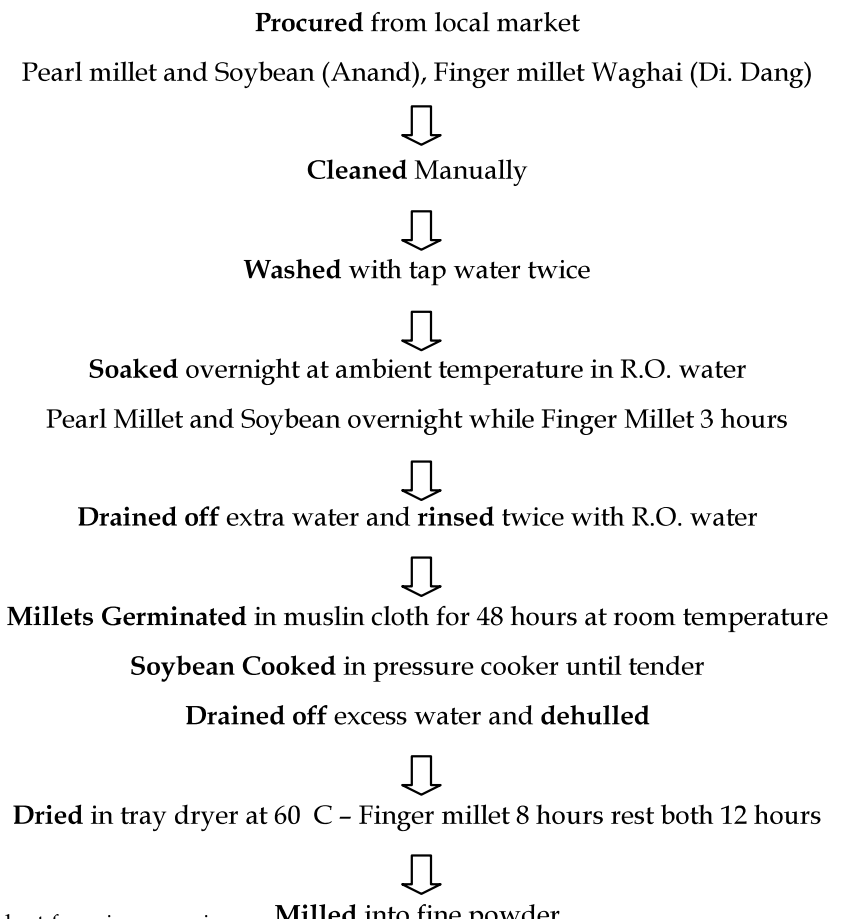

Fig. 1: Flow chart for grin processing

Table 1: Phase wise best accepted formulations

Phase	Pearl Millet (%)	Finger Millet (%)	Soybean (%)
I	35	35	30
II	40	20	40
III	30	35	35

Table 2: Nutritional composition of the selected weaning food formulations

Phase	Protein (g%)	Fat (g%)	Ash (g%)	Fiber (g%)	Carbohydrate (g%)	Calcium (mg%)	Iron (mg%)	Vitamin C (mg%)
I	11.88^{a} ±0.50	6.32^{b} ±0.25	2.15^{a} ±0.12	1.55^{a} ±0.17	46.41^{b} ±1.30	206.80^{ab} ±8.07	6.19^{c} ±0.48	35.27^{a} ±3.10
II	14.61^{b} ±0.24	6.59^{b} ±0.27	2.73^{ab} ±0.33	1.35^{a} ±0.15	39.80^{a} ±1.79	205.13^{ab} ±6.90	1.55^{a} ±0.03	56.77^{b} ±4.62
III	13.52^{b} ±0.35	6.75^{b} ±0.42	2.53^{a} ±0.18	1.50^{a} ±0.11	48.34^{b} ±1.06	227.57^{b} ±13.14	2.77^{b} ±0.18	38.73^{a} ±1.60
Control	11.5^{a} ±0.44	4.68^{a} ±0.45	3.38^{b} ±0.24	2.23^{b} ±0.09	44.24^{ab} ±2.25	187.06^{a} ±4.49	2.13^{ab} ±0.20	39.67^{a} ±1.19
SEM	0.40	0.36	0.23	0.13	1.67	8.74	0.27	2.96
CD	1.22	1.11	0.71	0.41	5.13	26.94	0.85	9.11
CV	6.14	11.81	17.19	16.05	7.45	8.46	17.37	13.87

Values are Mean ± SEM of nutritional analysis
Means bearing the same superscript within the column do not differ significantly ($p \leq 0.05$)
Cereal based weaning food mix available in market treated as control

Table 3: Antioxidant capacity of selected weaning food formulation

Phase	ABTS	DPPH	FRAP
I	10.15±0.58	39.48±0.91	45.47±1.29
II	14.06±0.36	43.92±2.56	48.93±1.64
III	13.81±0.40	48.83±3.69	53.76±1.16
Control	12.36±0.68	40.33±1.46	39.50±1.47
SEM	0.52	2.41	1.40
CD	1.62	7.42	4.33
CV	8.37	11.17	6.00

Values are Mean ± SEM of antioxidant capacity

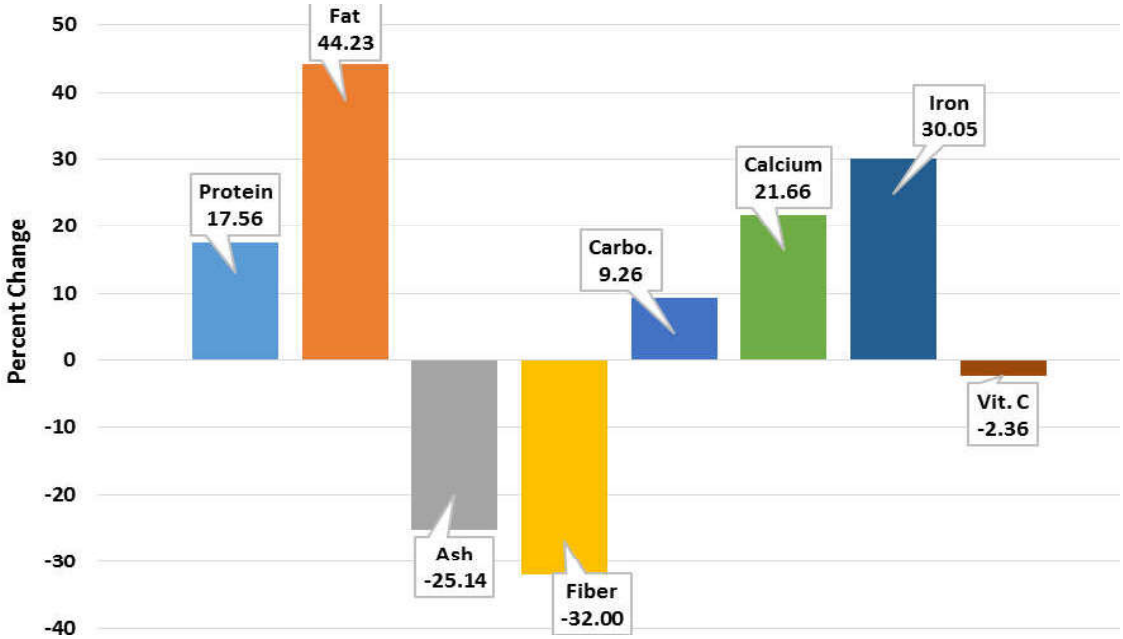

Chart 1: Percentage change in nutritional composition of experimental mix

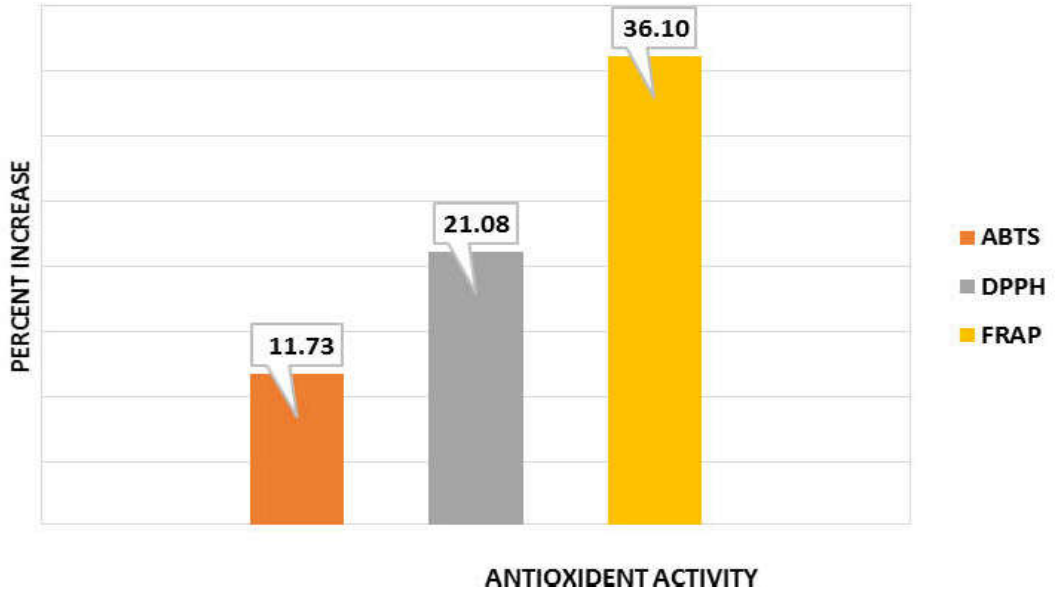

Chart 2: Percentage increase in antioxidant activity of experimental mix

bone and teeth development and blood, respectively and thus found the most valuable for the children were increased. The positive change for experimental formulation were 21.66 mg% and 30.05 mg% for Calcium and Iron, respectively as compared to control.

Vitamin C content was almost similar for both control as well as experimental formulation.

Antioxidants Capacity

Total antioxidant capacity is a measure which shows the combined action of all antioxidant compounds present in a specific food. The mean values are depleted in Table 3. Sample phase II showed the highest (14.06) ABTS % inhibition followed by phase III (13.81) and Phase I.

However, DPPH and FRAP (as TAC) % inhibition both were found the highest for finally selected product i.e 48.83 and 53.76, respectively. All the three activities were found higher as compared to control. The percent increment for ABTS, DPPH and FRAP was 11.73, 21.08 and 36.10% inhibition as shown in chart 2.

Other Finding

Cost of formulated mix was just Rs. 5.00 per 100 g, which is about 5 times less than the most weaning food mixes available in the market. One serving of formulated millet based weaning food provide 3.38g protein, 1.69g fat, 12g carbohydrate, 56.89mg calcium and 0.69g iron. To meet the nutritional need of infants, 100g of supplementary mix is recommended daily. The product can be stored for 4 months under ambient condition.

Conclusion

Millet based nutritionally balanced, homemade, low coast weaning food could be formulated. That contained more protein, fat, calcium and iron, the most beneficial nutrients for infants. It also superior in antioxidant activity. The product could be stored for sufficient time. That could be easily prepared and fed by rural mothers for their infants as supplementary food.

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