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DEVELOPMENT AND QUALITY ASSESSMENT OF HERBAL HEALTH MIX TO MITIGATE MICRONUTRIENT MALNUTRITION

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Malnutrition is a serious public-health problem that has been linked to a substantial increase in the risk of mortality and morbidity. It leads to different physiological and psychological problems in all segments of the population. A wide range of research is still going on to cut off the percent of micronutrient deficiencies. As part of this research, scientists developed different value added products by blending the neutraceutical and functional properties of foods. Cereals and millets with other food groups play an unusual role in the development of value added products. In the present study, an attempt has done to develop and standardize value added health mix with penny wort leaves. Indian pennywort, one such herb, which consists of many active principles such as Vallarine, Asiaticoside, Sitosterol, Tannin, Oxy-asiaticoside. Asiaticosideand has many beneficial qualities in preventing malnutrition, weight control and also enhances memory. Due to positive benefits of herbs to health, inclusion of these leaves with the locally available millets may not only compensates the deficiencies and also add variety to the food. This functional health mix is well acceptable in the community and rich in potential nutrients such as protein, vitamin-A and C which are precursors to meet the nutrient demands of the body.

Keywords: Malnutrition, Herbals, Indian pennywort, Micronutrients

INTRODUCTION

World health organization defined health as the "state of complete mental and social well-being and not merely the absence of disease and infirmity" (WHO, 2004). Food is a basic for survival of life. It is needed for the body's growth, repair and maintenance. Food provides energy required for all life activities. Satisfaction of hunger is usually the primary criterion for adequate food intake but satisfaction of hunger itself is not a safe guard for selection of proper food, when the types of variety foods available for consumption are many and constantly change, a scientific knowledge of nutrition in food becomes essential.

Micronutrient malnutrition or 'hidden hunger' is an important dimension of food and nutrition security from a global perspective and is caused by the lack of adequate micronutrients (vitamins and minerals) in the habitual diet (FAO/ILSI, 1997). Micronutrient deficiencies are common in populations that consume poor-quality diets lacking in dietary diversity, as their habitual diet is often deficient in these nutrients. They are therefore important from a public health perspective and exceed current estimates of global hunger and food insecurity. Micronutrient deficiencies impair cognitive development and lower resistance to disease in children and adults (Kennedey and Scholey, 2000).

Nevertheless, many studies suggest that poor nutritional status can indeed adversely affect brain function and impact on cognition and behavior. To a certain extent, appropriate correction of nutrient deficiencies can indeed lead to measurable improvement. Moreover, recent findings suggest that, even in situations of adequate nutritional

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status, the brain can actually be sensitive to short term variation of glucose availability.The adequate brain function is a prerequisite for efficient cognition and the performance of organized behavior (Oyediti *et al.*, 2006). Indeed, the uninterrupted activity of the brain is of vital importance to the survival of the organism since it ensures the continuous performance of many essential voluntary and involuntary functions. It is therefore imperative that the brain is protected from even short-term disruptions of its efficient working conditions (Donohoe and Benton, 1999).

Although food has classically been perceived as a means to provide energy and building material to the body, its ability to prevent and protect against diseases is starting to be recognized. In particular, research over the past five years has provided exciting evidence for the influence of dietary factors on specific molecular systems and mechanisms that maintain mental function. For instance, a diet that is rich in omega-3 fatty acids is garnering appreciation for supporting cognitive processes in humans. To overcome the problems obtained as a result of malnutrition, the need of nutrition rich food came into existence. A little modification in routine diet makes the diet balanced. Whole grains, millets, oily fish, tomatoes, pumpkin seeds are some of the brain boosting foods.

Herb is a plant or plant part used for its scent, flavor, and/or therapeutic properties (Oyediti *et al.*, 2006). Many herbs have a long history of use and of claimed health benefits. Due to positive benefits of herbs to health, inclusion of herbal foods in the diet may increase growth and development as well as enhances better memory and intelligence in children (Alzoreky and Nakahara, 2003). Indian pennywort, one such herb consists of many active principles such as Vallarine, Asiaticoside, Sitosterol, Tannin, and Oxy-asiaticoside. Asiaticoside in it leaves possess many beneficial qualities which help in preventing malnutrition, weight control and memory improving (Das, 2011). In view of above facts, a study was undertaken to formulate and develop a health mix with a combination of multigrain and herbs.

MATERIALS AND METHODS

Procurement of Ingredients

Value added health mix was prepared by using Whole wheat, Ragi, Bajra, Italianmillet, Soy, Green gram dhal, Cocoa powder, Sugar, Dry dates and Cardamom which were procured from the local super market in Tirupati. The fresh and green pennywort leaves were collected from Krishi Vigyan Kendra (KVK), Tirupati.

Processing and Formulation of Health Mix

All ingredients except pennywort leaves were cleaned for the removal of dust, stones and other foreign particles and then weighed according to the standard procedure. Selected good pennywort leaves were cleaned and washed thoroughly with fresh water to remove the surface dirt adhered to the leaves. Then the leaves were dried under shade for 5-7 days. The dried leaves were packed in airtight containers to incorporate into the value added product. The ingredients like Whole wheat, Soybean, Greengram dhal, Ragi, Bajra and Italian millet were soaked and kept for germination.Germinated grains and legumes were allowed for shade drying for four days. The ingredients wereroasted for 5-10 minutes to reduce the moisture content and roasting enhancesthe aroma of the product. Initially roasted ingredients were grinded, then continues the grinding by adding dried Indian pennywort leaves, cardamom, dry dates, sugar and finally blended cocoa powder until to obtain the fine powder. Various formulations were designed by using different proportions of ingredients to standardize the product, are presented in Table 1.

Four samples were worked out to standardize the value added health mix in laboratory. Three samples formulated

Table 1: Composition of Various Samples for Standardization of the Product

S. No.	Ingredients	Control Sample	Experimental Samples		
		T_0	T_1	T_2	T_3
1	Whole Wheat (g)	16	13	10	10
2	Bajra (g)	10	10	10	10
3	Italian Millet (g)	10	10	10	10
4	Ragi (g)	16	14	10	12
5	Green Gram Dhal (g)	10	10	10	10
6	Soya (g)	10	10	10	10
7	Cocoa Powder (g)	10	10	10	10
8	Sugar (g)	10	10	10	10
9	Dry Dates (g)	5	5	5	5
10	Cardamom (g)	3	3	3	3
11	Indian pennywort leaves	-	5	12	10
Total		**100**	**100**	**100**	**100**

with a combination of foods and herb and designated as experimental samples T_1, T_2, T_3. One sample treated as control (T_0) which was developed without incorporation of herbs. The formulation of ingredients was given in the above table.

Sensory Evaluation

Sensory evaluation is a scientific disciplines that analyses and measures human response to the developed/novel products, which ensure that the consumers get a quality product. All the samples were subjected to sensory evaluation with trained panel. Five point hedonic scale was used for sensory evaluation. Among the threeexperimental samples, T_3 got highest score for all sensory attributes. Hence the formula of T_3 was standardized in terms of ingredients and procedure and processing technology. The standardized health mix was subjected to sensory evaluation with children and their mothers to test the acceptability.

Assessment of Nutrient Composition of Health Mix

Nutrient analysis, i.e., moisture, protein, fat, carbohydrate, iron, vitamin-A and Vitamin-C were analyzed for both control and experimental samples. The standardized procedures were adopted for the assessment of the product, are given below.

Moisture Estimation: The moisture content of value added health mix was estimated by using indirect method (Oven drying) which isapproved by AOAC International for determining the amount of moisture in many food products.

Estimation of Protein: The Micro Kjeldahl method is used for analyzing protein content in food.

Estimation of Fat: The Soxhlet extraction is used for determination of total fat.

Estimation of Carbohydrates, Iron, Vitamin-A and Vitamin -C: The procedures were followed as per AOAC methods.

Shelf Life Study

Shelf-life is the length of time a food can be kept under stated storage conditions while maintaining its optimum safety and quality. Shelf life of a food begins from the time the food is manufactured and is dependent on many factors such as its manufacturing process, type of packaging, storage conditions and ingredients. Microbial analysis was carried out to assess the shelf-life of herbal health mix. The TPC and Yeast and Mold countwas evaluated in the developed value added health mix during the storage period.

Statistical Analysis

Statistical analysis was carried out using appropriate statistical methods. Mean, standard deviation and 't' test were applied and the results are deliberated in result and discussion head.

RESULTS AND DISCUSSION

The Indian pennywort is the best remunerative herb for brain cells and nerves, promotes intelligence, it is supplemented through tablets, tonic, syrup, lehyam, choornam, vati and rasayana, etc., but availability of food products are very rare because of its taste. To overcome such problem and promote it to utilize, the nutrient rich health mix with Indian pennywort leaves was developed and analyzed for its quality and safety. The results are presented and discussed.

Nutrient Composition of Health Mix

Nutrient composition for both experimental and control samples were analyzed in the laboratory for the essential nutrients such as Moisture, Protein, Carbohydrates, Fat, Iron, Vitamin-A and Vitamin-C. Results obtained in the analysis are presented in the Table 2.

Table 2: Nutrient Composition of Value Added Health Mix (per 100 g)

S. No.	Nutrients	Control	Experimental
1	Moisture (%)	1.9	3.11
2	Protein (g)	13.91	12.98
3	Carbohydrates (g)	29.8	29.8
4	Fat (g)	4.06	6.12
5	Iron (mg)	0.456	0.676
6	Vitamin-A (IU)	120.6	156.7
7	Vitamin-C (mg)	10.11	15.6

The data in the above table shows that the analyzed Nutritive Values per 100 g of sample. The moisture content in control sample is low (1.9%) when compared with experimental sample (3.11%). The reason might be the addition of Indian pennywort leaves in experimental sample which increases its moisture content. Hence, care must be taken in drying the leaves for further study.

The protein percentage in control sample is 13.91 g, where as in experimental sample it is 12.98 g, the difference

between control and experimental sample is very minute which is not significant (0.93 g). It was due to very low protein content of Indian Pennywort leaves of experimental samples. The carbohydrate percentage is same in both control and experimental sample, i.e., 29.8 g. The results were coincide with the results of forum of Indian culture and life style of India, 2009, that the cellulose content is extremely low in Indian Pennywort leaves.

The fat content in experimental sample is 6.12 g where as in control sample the fat content is 4.06 g. The fat content in the experimental sample is more when compared with control sample, because of the incorporation of Indian Pennywort leaves to the experimental sample. The results were coinciding with the results of Forum of Indian culture and lifestyle of India, 2009, that the leaves contain volatile oil, fatty oil, sitosterol, tannin and a resinous substances.

The Iron content of control and experimental samples were 0.456 mg and 0.676 mg respectively. When compared to the control sample, the iron content was slightly more in the experimental sample, because of the Indian Pennywort leaves which are rich in mineral content. The results were coincide with the results of the study carriedout by Sadan *et al.* (2006) on green leafy vegetables, where the green leaves like Indian Pennywort were rich in minerals like iron and calcium.

Vitamin-A content was more in experimental sample (156.7 IU) compared to control sample (120.6 IU). The enhanced vitamin-content in the experimental sample is due to the addition of Indian Pennywort leaves. Where the results were also coincide with the results of the study carriedoutby Sadan *et al.* (2006) on green leafy vegetables, where the β-Carotene content is more in green leaves like pennywort, Agathi, and Amaranth.

The vitamin-C content was more in experimental sample (15.6 mg), than the control sample (10.11 mg). The results obtained for vitamin C content was more in experimental sample compared with the control sample, because of the incorporation of Indian Pennywort leaves. The results were also coincide with the results of the study carried out by Sadan *et al.* (2006) on green leafy vegetables, where the green leaves like Indian pennywort leaves were rich in vitamin "C".

Sensory Evaluation of the Health Mix

The Sensory attributes were assessed for thedeveloped value added health mix by the mothers of school children and children are presented in Table 3.

The above data shows that the color and taste of the experimental sample was well accepted by the mothers compared with control sample. There is a significant difference between the control and experimental samples for both color and taste at 0.05 levels. For remaining attributes such as flavor, texture, appearance and overall acceptability,no significant difference was observed between control and experimental samples.

The above data shows that the color, taste and appearance of the experimental sample were well accepted by the children compared with control sample. There is a significant difference between the control and experimental samples for color, taste and appearance. For remaining attributes such as flavor, texture and overall acceptability, no significant difference wasobserved between experimental

Table 3: Sensory Evaluation of the Value Added Health Mix by Mothers

S. No.	Sensory Attributes	Health Mix		't' value	Significant Difference
		Control	Experimental		
1	Color	3.27 +0.70	3.93 +0.70	2.59	0.015*
2	Flavor	3.33 +0.49	3.73 +0.70	1.81	0.081
3	Taste	3.27 ±00.51	4.07 ±0.80	2.73	0.011*
4	Texture	3.53 ±0.64	3.93 ±0.80	1.51	0.141
5	Appearance	3.60 ±0.74	3.87 ±0.64	1.06	0.299
6	Overall Acceptability	3.67 ±0.62	4.00 ±0.53	1.58	0.125

Note: * Significant at 0.05 level.

Figure 1: Sensory Evaluation of the Health Mix by Mothers

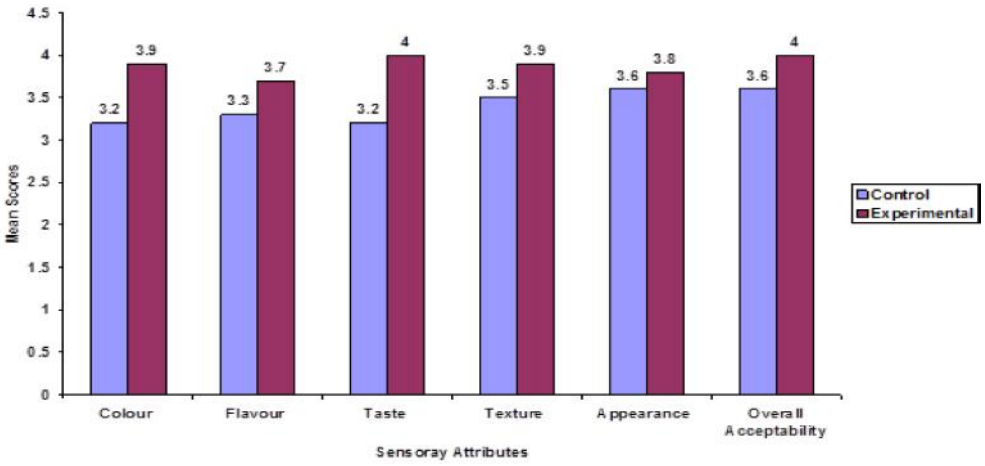

Table 4: Sensory Evaluation of the Value Added Health Mix by Children

S. No.	Sensory Attributes	Health Mix		't' value	Significant Difference
		Control	Experimental		
1	Color	3.40 +0.51	3.93 +0.70	2.38	0.024*
2	Flavor	3.53 +0.52	3.87 +0.64	1.57	0.128
3	Taste	3.47 ±0.52	4.93 ±0.70	2.07	0.048*
4	Texture	3.73 ±0.59	3.80 ±0.68	0.29	0.1776
5	Appearance	3.53 ±0.52	4.20 ±0.68	3.03	0.005**
6	Overall Acceptability	3.40 ±0.63	3.80±0.63	1.67	0.105

Note: * significant at 0.05 level and ** significant at 0.01 level.

Figure 2: Sensory Evaluation of the Health Mix by Children

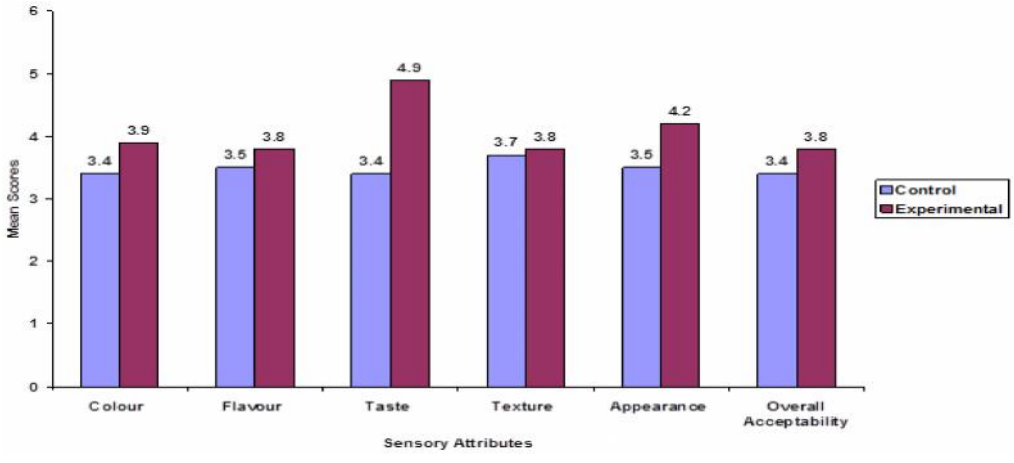

Table 5: Microbiological Analysis of Value Added Health Mix at Different Storage Periods

S. No	Parameters	O Days (cfu/g)		15 Days (cfu/g)		30 Days (cfu/g)		'F'-value		Significant Difference	
		Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental
1	Total bacterial count	1000.000+500.000	200.000+100.000	4000.000+2000.000	1000.000+0.000	6000.000+0.000	1333.333+288.675	13.412	32.714	0.006	0.001**
2	Yeast & Mould	10.000± 10.000	0.000+0.000	100.000± 50.000	1000.000+0.000	300.000± 0.000	100.00+50.000	79.32	10.92	0	0.010 **

Note: * significant at 0.05 level and ** significant at 0.01 level.

and control samples. The data and results show that the children and their mothers accept all the attributes of the health mix by assigning good rating to the product.

Shelf-Life Studies

The value added health mix wassubjected to microbial analysis to test theshelf life at 0, 15 and 30 days of storage period. The samples were analyzed for total bacterial coconut, yeast and molds. The results obtained during the shelf life studies are presented in Table 5.

The mean Total Bacterial count values for the experimental sample were 200.000±100.000, 1000.000±0.000 and 1333.333±288.675 during the storage periods of 0, 15 and 30 days respectively. The mean Total Bacterial Count values for control samples were 1000.000±500.000, 4000.000± 2000.000 and 6000.000±0.000 during the storage periods of 0 , 15 and 30 days respectively. A significant difference was observed between experimental and control samples at 0.01 levels during storage period.

The mean yeast and mold values for the experimental sample were 0.000±0.000, 10.000±0.000 and 100.000±50.000 during the storage periods of 0 days, 15 days and 30 days respectively. The mean yeast and moulds values for control samples were 10.000±0.000, 100.000±50.000 and 300.000±0.000 during the storage periods of 0 days, 15 days and 30 days respectively. The 'F' value obtained for experimental and control were 10.920 and 79.320 respectively. A significant difference was observed between experimental and control samples at 0.01 levels during storage period.

CONCLUSION

Malnutritionis a serious public-health problem that has been linked to a substantial increase in the risk of mortality and morbidity. Women and young children bear the brunt of the disease burden associated with malnutrition. The present study was carriedout for preventing malnutrition by developing health mix with Indian pennywort leaves which is a well-knownadaptogenic agent in Indian system of medicine (ayurveda), is believed to have beneficial effects in improving memory, treating anxiety and eczema. It also possesses antioxidant and antiepileptic properties. In clinical setting Indian pennywort has been documented to improve microcirculation.Hence the study was concluded that the value added health mix contains high nutritional values, medicinal values as well as low expensive.The herbal health mix can be promoted in any supplementary feeding programmes as a value added health mix.

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