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RESEARCH ARTICLE

FORMULATION AND EVALUATION OF INSTANT SOUP POWDER USING MILLETS

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ABSTRACT

The present study deals with formulation of instant soup powder using millets, oats, maizeand dehydrated vegetable powder. The selected millets were pre-processed, milled and blended in various proportions to formulate instant soup powders namely A, B, C and D. The results of sensory evaluation reveals that formulation A was found to best with overall acceptability score of 8.1 and the results highly correlates with rehydration ratio. Hence formulation A was selected for further study. The results of nutritional analysis indicate that, Formulated instant soup powder (FISP) was enhanced with protein and crude fibre content when compared to commercial soup powder (CSP). Similarly, total phenolic content and antioxidant content of FISP was found to significantly higher than compared to CSP. The outcomes of α-amylase inhibition disk assay indicate that, FISP retain of low glycemic index and can be supplemented to diabetic patients. The shelf-life properties were found to be good and it retained flavour and taste after three months of storage. Hence, millet based instant soup powder can be easily manufactured at low cost and it can definitely meet out the needs of growing functional food market.

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INTRODUCTION

Food processing industries holds remarkable growth and renowned as sunrise sector. It acts as a major drive for economic progression of the country. Food consumption has been changed during the past decade and need for instant food formulation is being increased. Food technology has made convenience foods possible and instant food products are easy to cook. Nutritional rich convenience foods formulation will have definite uprising and satisfies the market demands. Canned foods, convenience foods, frozen foods, dried foods, preserved foods, etc. comes under instant foods (Sowjanya and Manjula, 2016). Instant soup powders are similar kind of instant foods which have extended popularity in the recent years, by way of providing convenience, hygienic, extensible shelf life (Premavalli *et al*., 2005). A balancednutrition is obtained by including whole cereals, vegetables and pulses in soup formulations (Pandey *et al*., 2006). The rising awareness about nutrition and health care has increased the consumption of millets in recent years. Different varieties of millets includes pearl millet (*Pennisetumglaucum*), finger millet (*Eleusinecoracana*), kodo millet (*Paspalumsetaceum*), proso millet (*Penicummiliaceum*), foxtail millet (*Setaria italic*), barnyard millet (*Echinochloautilis*) and little millet (*Panicumsumatrense*). They are highly nutritional when comparable to major cereals such as wheat and rice (Parameswaran and Sadasivam, 1994) and proved to be unique among cereals due to the presence of calcium, dietary fibre, polyphenol proteins and antioxidant content (Devi *et al*., 2011; Ragaee *et al*., 2006). Moreover, millets are gluten free and can replace other common cereals in food formulations (Subhash and Hathan, 2014). Instant millet based food products deliver convenience, taste, texture, *colour*, and shelf-stability at economical cost (Ahmed, 2013). Increased intake of oat based food products is beneficial especially due to the presence of β-glucan, essential amino acids, unsaturated fatty acids and other dietary fibre which helps in lowering blood cholesterol. It is the only cereal containing a globulin or legume-like protein which is comparableto quality of soy protein (Melese, 2013). Hence, in view of its increased nutritional content oats was used in formulation of instant soup powder. Vegetables are rich in antioxidant and essential phytonutrient. In addition to their low calorie content, it provides high fibre and vitamins. In-spite of its increased nutritional content, vegetables are

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available year round and it can processed into value added product. Soup mix fortified dehydrated vegetables should be rehydrated and cook within minimum period to have nutritional and palatable product (Abeysinghe and Illeperuma, 2006).

As the formulation of functional foods products using nutritional and locally available raw materials have expected a lot of attentions, the present research work aimed to formulate instant soup fortified with millets, dehydrated vegetables and oats. Moreover its nutritional properties, antioxidant content, shelf life and microbial analysis were evaluated to study its nutraceutical properties.

MATERIALS AND METHODS

Selection of raw material

The millets like Foxtail millet (*Setariaitalica*), Pearl millet (*Pennisetumglaucum*), Finger millet (*Eleusinecoracana*), maize (*Zea mays*), Sorghum (*Sorghum bicolor*) and Oats (*Avenasativa*) were selected for soup powder formulation. Vegetables such as carrot, potato, onion, peas, garlic andginger were collected from local market. Other seasoning ingredients such as dehydrated onion flakes and garlic flakes, coriander powder, black pepper powder, cumin powder and black salt was purchased from local supermarket and used for the present study

Formulation of Instant soup Mix

Above mentioned vegetables weregraded, washed, peeled, sliced and blanched in hot water at 80˚C for 5 min and dehydrated in tray drierat 50˚C until it completely get dried. Tomatoes were sliced then dried. All the dehydrated vegetables were milled and sieved to the thickness of 0.5mm using NO.16 sieves. The selected millets and cereals were cleaned, ground and sieved off to a thickness of 1mm using No.60 sieves. It was kept in air tight container for further use. The production process flowchart of instant soup formulation is given in the Fig. 1. The recipes of formulated Instant Soup Mix namely A,B,C and D is illustrated in the Table 1.

Organoleptic Evaluation of the Instant soup Mix

The reconstitution of FISP was evaluated by conducting organoleptic evaluation by the method outlined byDimple and Rohanie, (2014). Initially, 50gms of all the FISP such as sample A, B, C and D were taken and mixed with water separately and heated for 7-10 minutes at 50°C. The appearance and consistency of soup was observed by 10 trained panel members. During flavour evaluation panelists rinsed their palates with room temperature water between samples. The rating for each characteristic was based on a Nine-point hedonic scale (9=like extremely; 1=dislike extremely).

Rehydration Ratio

Rehydration ratio was performed according to the method outlined by Krokida and Marinos-Kouris (2003). Total of 2g of four different samples FISP mix (A, B, C and D) were rehydrated using 20 ml distilled in a shaking water bath at constant temperature in agitation of 100 rpm. After 10 minutes, excess water was blotted with tissue paper and weight was measured. Rehydration ratio was evaluated the ratio of weight of rehydrated samples to the dry weight of the sample.

Nutrient Analysis of formulated instant soup mix

Moisture content and nutrient analysis such total carbohydrate, protein, fat, crude fibre, phosphorus, calcium and iron was evaluated for both formulated Instant Soup Mix (FISP) and commercial soup powder (CSP) using AOAC method (2000).

Total phenolic content, Antioxidant activity and Antidiabetic Activity

Total phenolic content of FISP and CSP was determined using the Folin-Ciocalteu reagent method and Antioxidant activity was analyzed by DPPH assay. Antidiabetic activity for FISP and CSP was assessed through α-amylase inhibition disk assay (Apostolidis *et al*., 2006). FISP and CSP extract was mixed with α-amylase solution. The mixture was loaded on sterile paper disk and placed in Petri plates containing starch agar medium with control as α-amylase solution. After incubation, 5 mL of iodine stain was added and zone of inhibition was observed. The percentage of α-amylase inhibition was calculated using the following equation

$$\%\ \text{of}\alpha\ \text{amylaseinhibition} = \frac{\text{control} - \text{sample}}{\text{control}} \text{X}\ 100$$

Shelf life and Cost analysis

FISP was packed in air tight high density poly ethylene bags under sterile conditions and kept in room temperature (28±2°C). Samples are taken at monthly intervals for a period of three months and various parameters such as overall acceptability and microbial load was evaluated. The cost per kg of FISP was calculated from the total quantity of ingredient used along with 10% of miscellaneous cost and it was compared with CSP.

RESULTS AND DISCUSSION

Organoleptic Evaluation of the Instant soup Mix

Sensory evaluation is an essential concept in food product development as it reduces the risk of product failure and links the consumer perception about quality of food (Dimple and Rohanie, 2014). Even though formulated food products are nutritious, without taste and flavour the product cannot reach market in successfully. The results of sensory evaluation of FISM are illustrated in the Table 2. The data reveals that, formulation A was found to be highly acceptability with significant difference when compared to other formulation. The score ranged from 7.9 to 8.4 for all the parameters. Similarly, the results of consistency and dissolution are aligned parallel to each other for all the formulations. Formulation D gave minimum results with overall acceptability of 5.9. It reveals that, addition of oats powder enhance the taste, flavour, consistency and colour of soup.

Table 1. Formulation of Instant soup Mix

Ingredients	Formulation			
	A	**B**	**C**	**D**
Foxtail millet	30	25	10	30
Pearl millet	30	25	10	30
Finger millet	30	25	10	30
Sorghum	30	25	10	30
maize	60	20	80	80
Oats	20	100	80	-
Dehydrated vegetable mixture	10	10	10	10
Seasoning Ingredient*				
Black Pepper powder	10	10	10	10
Dehydrated onion flakes	05	05	05	05
Dehydrated garlic flakes	05	05	05	05
Coriander powder	05	05	05	05
Cumin powder	05	05	05	05
Black salt	10	10	10	10

***** Added to formulated mix during soup preparation

Table 2. Sensory evaluation of the Formulated Instant Soup Mix

Formulation	Taste	Flavour	Consistency	Colour	Appearance	Dissolution rate	Overall Acceptance
A	$8.1^{a}\pm$ 0.74	$8.2^{a}\pm$ 0.63	$8.4^{a}\pm$ 0.70	$8.4^{a}\pm$ 0.70	$8.4^{a}\pm$ 0.52	$7.9^{a}\pm$ 0.67	$8.1^{a}\pm$ 0.23
B	$6.7^{bc}\pm$ 0.67	$6.8^{bc}\pm$ 0.78	$5.8^{bc}\pm$ 0.78	$6.7^{bc}\pm$ 0.48	$7.3^{bc}\pm$ 0.67	$6.7^{bc}\pm$ 0.48	$6.6^{bc}\pm$ 0.27
C	$6.8^{b}\pm$ 0.42	$6.7^{b}\pm$ 0.73	$7.1^{ab}\pm$ 0.73	$6.7^{b}\pm$ 0.48	$7.6^{ab}\pm$ 0.51	$7.0^{ab}\pm$ 0.66	$6.9^{b}\pm$ 0.16
D	$5.6^{c}\pm$ 0.51	$6.6^{c}\pm$ 0.98	$5.7^{c}\pm$ 0.48	$5.8^{c}\pm$ 0.63	$6.1^{c}\pm$ 0.73	$6.0^{c}\pm$ 0.81	$5.9^{c}\pm$ 0.33

Values are mean of ten replicates; ± SD, values in the column followed by the similar alphabets are not significantly different at 0.05 level.

Table 3. Nutrient analysis of Formulated Instant soup powder mix and commercial soup powder mix

S.No	Parameters	**FISP** (100gm)	CSP (100gm)
1	Moisture (%)	3.7	3.9
2	Carbohydrate (gm)	62.8 ± 0.33	60 ± 0.56
3	Protein(gm)	9.74 ±0.52	6.52 ±0.59
4	Fat(gm)	3.46 ± 0.73	3.35 ±0.33
5	Energy (kcal)	319.29 ±1.57	300.25±0.56
6	Crude fibre(gm)	3.69 ±0.33	1.5±0.56
7	Phosphorus (mg)	193.23±0.53	180±1.20
8	Calcium(g)	55.8 ±0.55	43.8±0.73
8	Iron (mg)	9.64±0.56	8.23 mg±0.73

Values were means ± SD

Table 4. Overall Acceptability of FISP mix

Description	Scale point	No. of responses		
		Overall Acceptability		
		1st month	**2nd month**	**3rd month**
Like extremely	9	3	3	2
Like very much	8	4	3	3
Like moderately	7	2	2	3
Like Slightly	6	1	1	1
Neither like or dislike	5	-	1	1
Dislike Slightly	4	-	-	-
Dislike moderately	3	-	-	-
Dislike Very much	2	-	-	-
Dislike extremely	1	-	-	-
No. of respondents		**10**		

Table 5. Microbial analysis of FISP

Microorganisms	Formulated instant soup mix **(CFU/gm of sample)**					
	15th day	**30th day**	**45th day**	**60th day**	**75th day**	**90th day**
Total bacterial count	-	1.3×10^3	3.0×10^3	7.5×10^3	8.6×10^3	10.8×10^3
Yeast/Mould Count	-	-	-	-		1.2×10^3

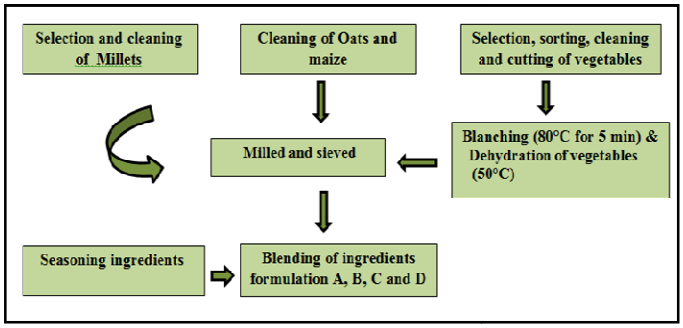

Fig.1. Overall Methodology of Formulated Instant Soup Mix

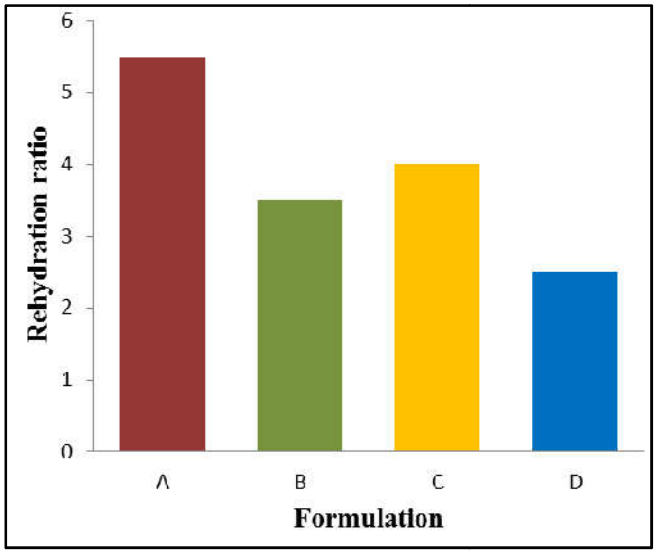

Fig. 2. Rehydration ratio of formulated instant soup powder mix

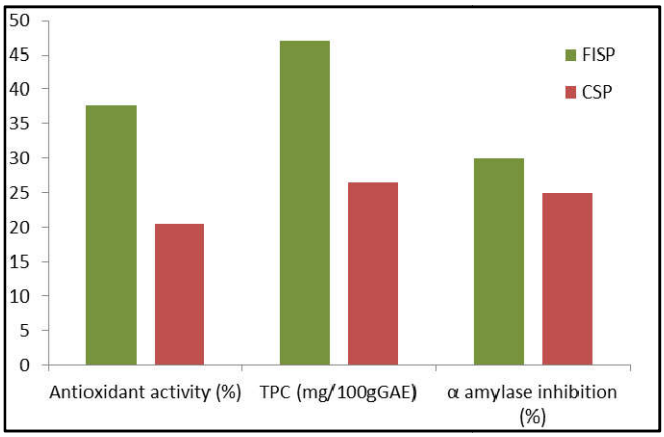

Fig. 3. Total phenolic, Antioxidant and Antidiabetic activity content of FISP and CSP mix

On the other hand, excess incorporation of oats powder also makes the soup in thicker and hides flavour and aroma. Hence, ingredient ratio mixed in formulation A was found to good and selected for further analysis. Instant soup powder formulated using *Moringa oleifera*, *Solonum trilobatum* and *Centellaariatic* herbs was highly accepted by panel members and gave higher scores in sensory evaluation assay (Chandramouli *et al*., 2012).

Rehydration Ratio

Rehydration process aimed at restoration of dehydrated products when contact with water (Lewicki, 1998). Fig. 2 represents the rehydration ratio of different formulated recipes of instant soup powder. Highest rehydration ratio of 5.5gm was observed for formulation A followed by formulation C with 4 gm. The result of rehydration ratio is highly correlated with sensory evaluation carried out by panel members. Addition of 30gm minor millets along with oats and sufficient quantity of maize flour and dehydrated vegetables has increased rehydration ratio and which was reflected over the improved taste, consistency dissolution rate. Excess supplementation of oats in formulation B and maize powder in formulation D was unable to gain rehydration ratio which relates to have lower scores in sensory evaluation. Davoodi *et al.* (2007) has reported similar range of rehydration ratio of 3.6 to 4.98 for dried tomato slices. The present study correlates with research conducted by Pushkala (2014) whereas highest rehydration ratio of 3.98 was obtained for dehydrated papaya powder.

Nutrient analysis of formulated instant soup mix

The Formulated Instant Soup Mix (FISP) was prepared using different millets and cereal. The product was enriched with several dehydrated vegetables and it was found to be superior in nutritive values and appearance was pale yellow in colour and aroma was found to highly acceptable. The nutrient analysis of the formulation is represented in the Table 3 and it was compared with locally available commercial soup powder (CSP). The moisture content present in FISP and CSP was found to be acceptable. The carbohydrate content of FISP (62.8 gm)and CSP (60gm)was found to be almost similar with no significant difference. However, protein content was found to be high in FISP of 9.74gm when compared to CSP of 6.52gm. Similarly, Crude fibre was found be high in FISP with the values of 3.69g. Other nutrients such as phosphorus, calcium and iron were found to be almost similar without any significant difference. Amaland Azza, (2014) has reported that dried vegetarian soup powder has reasonable amounts of the required nutrients particularly, protein, carbohydrates, fats, Fe and Zn. The nutrient profile of the banana peel instant soup mix was found to be rich in calories, carbohydrates and minerals (Megha, 2015).

Total phenolic content, Antioxidant activity and Antidiabetic Activity

The results of antioxidant content and total phenolic content of FISP and CSP were illustrated in Fig 3. Addition of millet powder has drastically improved the total phenolic content and antioxidant activity of FISP when compared to CSP and vast significant difference was observed. In accordance to the present results, Anoma *et al*. (2012) has reported that millets are superior in total phenolic content and antioxidant. Peterson *et al*. (2001) have also reported that phenolic compounds are mainly concentrated in the bran of oats. Hence, phenolic compounds present in the oats have improved the antioxidant and total phenolic content to substantial amount. The result of α – amylase inhibition assay clearly reveals that, FISP possess antidiabetic activity with 30 % of inhibition than compared to

CPS which gave 25% of inhibition. Hence the above result reveals that, cereals can bereplaced by millet and oat in food formulations which might improves the nutraceutical properties.

Shelf life and Cost analysis

Shelf life of the FISP was evaluated through conducting sensory analysis at the interval of thirty days and number of responses for each point of Nine point Hedronic scale is illustrated in the Table 4. Initially, three panel members have positive response of" like extremely" followed by four members of "like very much" and almost similar scores were followed in second month and third month except one responses as "Neither like or dislike". However, no responses were registered on "Dislike" level. Cost per 100gm of FISP was found to be Rs.30/- and it was affordable to all class of people. Moreover it is highly nutritional and rich in antioxidant activity. In additional to that, it poses antidiabetic activity and can utilize by all age group of people. FISP was subjected to periodical microbial analysis to assess the shelf-life of the product for the period of three months and results were depicted the Table 5. It reveals that, initially on 30^{th} day, bacterial load of $1.3X10^3$ cfu/ gm of sample was observed. However, Yeast/Mould Count was not present until 75^{th} day observations. FISP mix was fortified with dehydrated vegetables powder under very low moisture content (Table 4) which might not probably encourage the growth of fungal and bacterial colonies. Moreover, seasoning ingredients such as black pepper powder, cumin powder and black salt possess antimicrobial activity and will acts as preserving agents. After 90 day, total bacterial count and yeast /mould count was found in the range of 10.8×10^3 and 1.2×10^3 and the resultant values were found to be lower than that of the standard grade. Above results highly correlate with work carried out by Senanayake *et al.* (2014) were the formulated dry soup powder had minimum growth of bacterial colonies and had six month of shelf life.

Conclusion

The present research reveals that millets, oats and maize powder along with dehydrated vegetable powder added to instant soup powder mix was found to be superior in quality. Formulation A ranked high in sensory attributes of taste, flavour, consistency, colour, appearance and overall acceptability. FISP was highly nutritional and showed significant difference when compared to commercial formulated mix. Similarly shelf life was found to be good when stored under ambient condition. Cost of production was also found to be in acceptable level. Formulation was more convenient than traditional product and instead of using corn starch as thickeners, millets and oats powders act as best substitute and hence the FISP can attain its popularity as functional food product.

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