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Development and Process Standardisation of Millet Based Instant Appe Mix and its Quality Evaluation

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ABSTRACT: The present investigation attempts have been made to formulate the millet based instant appe mix and its quality evaluation. Appe is famous fermented breakfast food product of south India. Appe batter preparation includes the soaking, grinding and fermentation process. Preparation of appe batter is very lengthy and time consuming process. So the major challenge is to provide convenience food product to consumers having the good nutritional and health benefits. The major contribution have been made to formulate instant appe mix powder by drying the prepared batter at 70°C in cabinet tray drier and its evaluation for the parameters such as, organoleptic characteristics, proximate composition, mineral analysis and shelf life study analysis.

The product was prepared by utilizing rice, black gram, finger millet and foxtail millet. On the basis of nutritional significance ingredients were selected. The formulation with 40g rice, 20g black gram, 20g finger millet and 20g foxtail millet was found to be more acceptable based on the organoleptic evaluation. The nutritional study revealed that the prepared appe mix powder contains carbohydrate (72.4 ±0.01 %), protein (12.04±0.15%), fat (1.46±0.01%) and crude fiber (3.4±0.01%) respectively. Energy content of millet based instant appe mix was 350.92 ±0.73 kcal. The mineral composition of selected appe mix powder was found to be good source of minerals with compare to control and it is rich source of calcium (102.5±0.98mg), magnesium (104.1±0.98mg) and phosphorus (222.53±1.66mg). Final batter was prepared by reconstituition of appe mix powder with normal water with the ratio 1:1.4 (100g of appe mix powder: 140ml of water). The prepared product was found to be having shelf life of 75days at room temperature in HDPE aluminium laminated standing pouch.

Keywords: Quality, Millets, Orgenoleptic, Nutritional, Reonstitution, Shelf life.

INTRODUCTION

Instant mix food products achieved an important role in humans life because of its easy methods of preparation. Instant mixes are also known as convenience food products and they are simple, convenient, easy and fast to prepare. Instant mixes made a time saving options for the consumers with their busy life schedule. 'Instant Food Mix' means process where in ingredients are premixed. It helps to save very important resources such as time and energy (Ransumithila and Saravanakumar, 2019). These types of food products are prepared by reconstitution process before its consumption. Production status of Instant food products in south Asian country of India in the year 2015 was 372.6 thousand metric tons and in year 2020 the production status volume amounted above 490 thousand metric tons. Presently in Indian market instant upma mix, instant soojihalwa mix, instant pulav mix, instant doosa mix, instant dhokla mix and instant idli mix are available.

Appe is fermented cereal/legume based breakfast food product. Appe is known as pancake and it was originated in south India. Due to its spongy texture, attractive appearance, taste and flavor it achieved an importance in food category. It is easy to digestible with good nutritive value with combination of carbohydrate and protein. Fermentation process improved the nutritional profile of the food product (Giorgio, 2004). The process of fermentation enhance digestibility, improves flavor and aroma, advancing health benefits with biological enrichment of food substrates with protein, essential amino acids, essential fatty acids, and vitamins (Sathe and Mandal, 2016). With concern to the increasing health consciousness of consumer's cereal and millet based fermented products achieved popularity among the food groups (Roopa *et al*., 2017).

Rice (*Oryza sativa* L.) is one of the most cultivated and important food crop of the world. In the production of rice India ranks second after China with the production of 155.682 million metric tons per annum. West Bengal, Punjab, Uttar Pradesh, Andhra Pradesh, Tamil Nadu and Bihar are the top rice producer states of India. Rice is good source of protein and contains all 8 essential amino acids, necessary for building blocks for strong muscles. Rice contains 6.75% protein, 0.14% fat, 0.28% ash, 81.80% carbohydrate and 0.80% fiber (Oko *et al*., 2012). Rice is low-fat complex carbohydrate that is immediately digested and rapidly made accessible to the muscles and

other body parts and acts as ideal source of energy. Rice is one of the cereals that is gluten free and rarely causes unpleasant reaction or digestive difficulties. Due to the Distinctive functional properties of rice make it a desirable grain to be utilized in value-added products.

Black gram (*Vigna mungo* L.) annual pulse crop originated in India. India is the world's largest producer of black gram and produces about 1.5 to 1.9 million tons of black gram (urad) annually from about 3.5 million hectares of area, with an average productivity of 500 kg per hectare. In India Maharashtra, UP, AP, Orissa, Tamil Nadu, Rajasthan, Chhattisgarh and Madhya Pradesh are the top cultivators and producer of black gram. It is part of diet for millions of people and a cheap source of protein with 17-34% of protein in Seeds (Gour, 1993). Black gram has a mucilaginous material which makes it a valuable ingredient in dosa and idli preparation. Black gram is perfect combination of all nutrients, which includes proteins (23%), carbohydrates (51%), fat (1.7%), ash (3.17%), zinc (3.00mg), iron (5.97mg) and calcium (55.64mg) (Anjali and Rani, 2018).

Millet is one of the indigenous foods known to human and has been widely used in India as a staple food for thousands of years. Widely cultivated millets are Finger millet, Foxtail millet, Pearl millet, Barnyard etc.(Anbukkani *et al.,* 2017).Finger millet (*Eleusine coracana* L.*)* is also known as ragi and mandua and significant staple food in India. India is the major producer of finger millet contributing nearly 60% of the global production (Shukla and Srivastava, 2011). In India it is broadly cultivated in the states of Karnataka, Tamil Nadu, Andhra Pradesh and parts of North India. Finger millet is a good source of protein, fat and minerals. Finger millet is one of the minor cereals, which is nutritionally significant in terms of high calcium, phosphorous, iron and zinc. Finger millet is rich in calcium (0.34%), dietary fiber (18%), phytates (0.48%), protein (6%–13%) minerals (2.5%–3.5%), and phenolics (0.3%–3%). It contains the essential amino acids like thiamine, riboflavin, methionine, isoleucine, leucine and phenylalanine. It has distinguished health beneficial properties, such as anti-diabetic (type 2 diabetes mellitus), anti-diarrheal, anti-ulcer, anti-inflammatory, anti-tumerogenic, atherosclerogenic effects, anti-microbial and antioxidant properties noted (Chandra *et al.*, 2016).

Foxtail millet (*Setaria italica*) one of the oldest cultivated millets in the world and it is cultivated in about 23 countries in Asia, Africa, and America. Foxtail millet ranks second in the total world production of millets. In India, at present foxtail millet is cultivated on a limited area in Karnataka, Telangana, Andhra Pradesh, Maharashtra, Tamil Nadu, Rajasthan, Uttar Pradesh etc. Foxtail millet is rich in the minerals, the protein content is higher among millets and major cereals and also the amount of fibres (Hariprasanna, 2016). Foxtail millet per 100 gm is fat (4.3gm), minerals (3gm), protein (12.3gm), calcium (31mg), carbohydrate (60.9gm), phosphorous (290mg) and dietary fibre (14gm). Foxtail millet is generally utilized not just as an energy source for pregnant and lactating ladies, yet in addition for the sick individuals and kids, and particularly for individuals with diabetes (Singh *et al.,* 2017). Presence of foxtail millet in diet helps in the development of body tissue and energy metabolism.

In light of the above nutritional profile of rice, black gram, finger millet and foxtail millet, the present research study was carried out for the formulation of Instant Appe mix with utilization of cereal, pulse and millets with the special focus on development of convenience food product with reduction of time and saving energy. Product formulation was carried out and quality evaluation of prepared appe mix including organoleptic, proximate composition, physical properties, mineral composition and shelf life study analysis carried out to achieve final objective.

MATERIALS AND METHODOLOGY

The present research work was carried out in Department of Food Engineering with collaboration of Department of Food Chemistry and Nutrition in College of Food Technology, VNMKV, Parbhani during year 2020-21.

A. Materials

Ingredients for the production of millet based instant appe mix such as rice, black gram dal, finger millet and foxtail millet were procured from the Akar super shop Parbhani, Maharashtra, India. All the required chemicals and reagents of analytical grade were procured from the well reputed chemical distributer companies and used for the chemical analysis as such. Glass wares used during research work obtained from department of Food Chemistry and Nutrition College of Food Technology, VNMKV, Parbhani, Maharashtra.

B. Methods

Processing methods and preparation of millet based instant appe mix. Preparation of millet based instant appe mix was carried out as per the formulation given in Table 1. The good quality of ingredients were selected and cleaning was carried out to remove the extraneous matter. Weighing was done as per the recipe formulation. Selected grains were washed two-three times under the running tap water. Then the ingredients were soaked separately in the four vessels. Soaking of rice was carried out for 8hrs while for black gram dal, finger millet and foxtail millet soaking was carried out for 7hrs. After soaking grinding was carried out, in this process coarse grinding of rice was done and fine grinding of black gram dal, finger millet and foxtail millet was done. Batter preparation was carried out by mixing of all the grinded material with the addition of water to achieve the required consistency of appe batter. The prepared batter was kept for fermentation upto 10hrs. After fermentation mixing was carried out and batter was spread in try by marking the height of 1mm thickness (Roopa *et al.*, 2017). The spread batter was dried in cabinet tray drier at 70°C for 6 hrs. After drying process grinding of dried matter was carried out using grinder. Particle size distribution was carried out using digital sieve shaker, 75% of appe mix powder with 425 µm particle size and 25% appe mix powder with 500 µm particle size was considered as standard.

Table 1: Formulation of appe mix.

Sample	Ingredients			
	Rice (g)	Black gram (g)	Finger millet (g)	Foxtail millet (g)
Control	75	25	00	00
T_1	60	20	10	10
T_2	50	20	15	15
T_3	40	20	20	20
T_4	30	20	25	25

Packaging of appe mix was done in the HDPE aluminium laminated standing pouch (Farheentaj *et al*., 2017). The prepared appe mix powder was stored at room temperature.

C. Different Analysis

Organoleptic Analysis. Organoleptic evaluations of all 5 samples (control and T_1 - T_4) were carried out for the acceptability based on 9 points Hedonic scale. Samples were evaluated on the basis of appearance, color, taste, flavour, texture and overall acceptability. Scores were given on Hedonic scale represent 9 for like extremely while 1 for dislike extremely. Evaluation was carried out with the help of trained and semi trained panellists by providing respective evaluation sheet to individual member. Appe mix powder, prepared appe product was given along with drinking water and taste breaker. Average score was selected for the selection of standardised product formulation.

Proximate Analysis. Analysis was carried out to determine the proximate composition of the selected (T_3) and control appe mix powder. Moisture content of the product was determined by dry oven method (AOAC, 2000). The dry moisture free sample further used for the analysis of proximate constituents like fat, protein, crude fibre, and ash content (AOAC, 2000). Carbohydrate content was calculated by difference method (Wadikar *et al*., 2021). Total energy of appe mix was calculated using conversion formula by multiplying carbohydrate, fat and protein by 4, 9 and 4 respectively (Wandhekar *et al*., 2020). Mineral solution prepared by digesting the ash sample and minerals such as calcium (Ca), magnesim (Mg), phosphorus (P), zinc (Zn), iron (Fe) and copper (Cu) were determined by the standard process given by (Ranganna, 1986). All proximate constituents were analysed in triplicate and mean score was considered.

Physical properties of appe mix powder. The physical properties of appe mix powder such as, bulk density, tap density, true density, compressibility index, porosity, static friction and angle of repose of the selected (T_3) sample were evaluated (Micha,1983).

Reconstitutional properties of appe mix powder. The parameters such as water absorption capacity (WAC), wetability, time required for reconstituition and ratio of appe mix powder to water were determined (Kumar *et al*., 2017 and Wandhekar *et al*., 2020).

Shelf life study analysis of appe mix powder . In this study selected sample (T_3) was kept at room temperature for shelf life study in different packaging material including PP, HDPE standing pouch, HDPE aluminium laminated standing pouchand PET bottle. The storage studies for the parameters, moisture content, weight, Water absorption capacity and overall acceptability was carried out for 75days by studying the all parameters after interval of each 15days (Farheentaj *et al*., 2017).

RESULTS AND DISCUSSION

A. Organoleptic evaluation of prepared appe mix powder

Organoleptic evaluation of appe mix powder carried out with the help of trained and semi trained panel members using the 9 point headonic scale. The parameters like appearance, color, taste, flavour, texture and OAA was considered. The mean score of different organoleptic characteristics of the appe mix with prepared product for the formulations are summerised in the Table 2 and the same data also presented by spider plot graphical representation (Fig. 1) (Wandhekar *et al*., 2020).

The organoleptic attributes was scored based on 9 point headonic scale ranges form 9 for like extremely to 1 for dislike extremely. The results obtained from the organoleptic score revealed that there was highest overall acceptability score (8.1) for the T_3 sample with compare to control. For the parameters like color, flavour and texture sample T_3 showed the highest score. While sample T_4 showed the lowest score for all the parameters with overall acceptability score (6.5).

Table 2: Organoleptic evaluation of appe mix powder.

Sample	Organoleptic attributes					
	Appearance	Color	Taste	Flavour	Texture	OAA
Control	7.9	7.9	8.1	7.9	7.8	7.9
T1	7.1	7.8	7.9	7.5	7.6	7.5
T2	7	8	8	7.8	7.9	7.8
T3	8	8.1	8.2	8.1	8	**8.1**
T4	6	6	6.5	6.8	7.2	6.5
SE ±	0.029	0.010	0.065	0.081	0.083	0.115
CD@5%	0.087	0.040	0.190	0.238	0.246	0.337

*Each value represents the average of three determinations

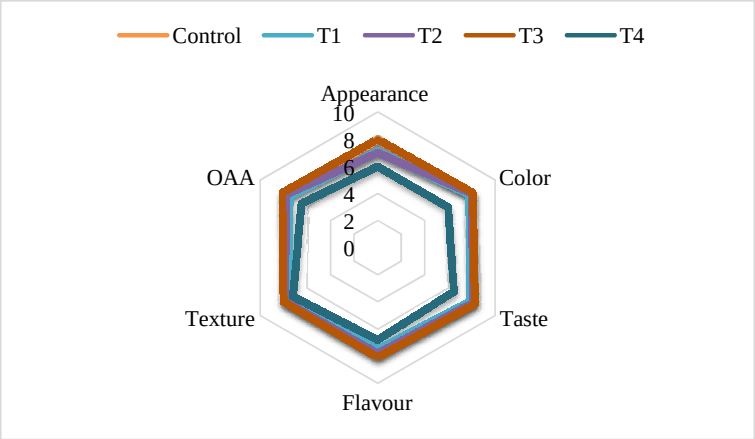

Fig. 1. Organoleptic evaluation of appe mix powder.

Increasing the concentration of millets 25% or above that was found to be unacceptable by the consumers due to the flavour and odour of millets. So the acceptable limit of the finger millet and foxtail millet was found to be acceptable at 20%. The study also revealed that due to fibrous nature of foxtail millet and finger millet the prepared product was soft and spongy in texture. Incorporation of finger millet helped to enhance the colour attributes. By considering the above parameters it was found that sample T_3 was having the highest score and superior than other samples hence it was selected for the further studies.

B. Proximate composition of appe mix powder

Proximate comosition helps to analyse the nutritional content of the sample.Proximate composition of control and selected sample T_3 was carried out and parameters like moisture, protein, fat, carbohydrate, crude fibre and ash content were evaluated. The obtained results are presented in the Table 3.

The data obtained from the Table 3 revealed that the appe mix powder comes under the category of non-perishable food commodity as moisture content in control and T_3 sample was 5.55±0.030 and 5.51±0.10 % respectively. With compare to control T_3 sample contains more protein and it was observed that protein content of control and T_3 sample was 11.03±0.02 and 12.04±0.15 % respectively. The increase in the protein content of the product was observed because of the soaking and fermentation process (Satheand Mandal, 2016). Fat content of the control and T_3 sample was 1.04±0.03 and 1.46±0.01 %. T_3 sample contains more carbohydrate 72.4 ±0.01 % than the control sample 69.01±0.11 % as the millets were found to be good source of carbohydrate (Sai Prasanna *et al*., 2020). Crude fibre content of the T_3 sample was found to be more than control sample as foxtail millet having the good quantity of fibre content and fibre was found 1.94±0.02 and 3.4±0.01 % in control and T_3 sample (Changmei and Dorothy, 2014). Ash content in the control and T_3 sample was 1.57±0.03 and 3.35±0.01 % respectively. The ash content of selected sample was moe than control due to the incorporation of finger millet and foxtail millet. Selected sample found to be the good source of nutrrients with compare to control. The obtained data narrated that the sample T3 was the good source nutrition with good amount of protein, carbohydrate and crude fibre.

Table 3: Proximate composition of appe mix powder.

Parameters	*Values/100g	
	Control	T_3
Moisture (%)	5.55±0.030	5.51±0.10
Protein (%)	11.03±0.02	12.04±0.15
Fat (%)	1.04±0.03	1.46±0.01
Carbohydrate (%)	69.01±0.11	72.4 ±0.01
Crude fibre (%)	1.94±0.02	3.4±0.01
Ash (%)	1.57±0.03	3.35±0.01

*Each value represents the average of three determinations

C. Energy value of appe mix powder

Total energy of sample was calculated by multiplying the carbohydrate, protein and fat by 4,4 and 9 respectively. The obtained data was presented in Table 4 as belows.

The data obtained from the Table 4 revealed that the control sample of Appe mix contains 329.59±0.83 Kcal total energy per 100g. The total energy of the selected sample T3 was found to be good source of energy with 350.92 ±0.73 Kcal per 100g respectively. The energy content of selected sample was found to be high because of the high concentration of carbohydrate, protein and fat in prepared sample.

Table 4: Energy value of appe mix powder.

Sample	Proximate composition/100g			Total energy (Kcal)
	Carbohydrate (g)	Protein(g)	Fat (g)	
Control	69.01±0.11	11.03±0.02	1.04±0.03	329.59±0.83
T_3	72.4 ±0.01	12.04±0.15	1.46±0.01	350.92 ±0.73

*Each value represents the average of three determinations

D. Mineral composition of appe mix

Minerals like calcium (Ca), magnesim (Mg), phosphorus (P), zinc (Zn), iron (Fe) and copper (Cu) were analysed for the control and selected sample and obtained results are summerised in the Table 5.

The mineral content of prepared appe mix for the control and selected sample was evaluated and it was found that the selcted sample (T3) contains high amount of minerals than control sample. Obtained data revealed that calcium, magnesium and phosphorus content of selected sample was 102.5±0.98, 104.1±0.98 and 222.53±1.66 mg/100g respectively. where as the mineral composition of control sample for calcium, magnesium and phosphorus was 40.36±0.61, 85.41±0.71 and 177.66±2.51mg/100g respectively. The significantt increse in the mineral composition in the selcted sample was due to the incorporation of millets (Gull *et al*., 2014). Zinc, iron and copper content of the control sample was found to be 3.26±0.02 , 2.20±0.01 and 0.44±0.03mg/100g. For the selected sample the mineral composition with respect to zinc, iron and copper was found to be 2.69±0.08, 2.83±0.01 and 0.64±0.04 mg/100g respectively. With the obtained study it was narrated that the utilization of millet will helps to achieve the required amount of minerals to fullfill the daily requirement (Wang *et al.*, 2011).

Table 5: Mineral composition of appe mix powder.

Parameters	Values (mg/100g)	
	Control	T_3
Calcium	40.36±0.61	102.5±0.98
Magnesium	85.41±0.71	104.1±0.98
Phosphorus	177.66±2.51	222.53±1.66
Zinc	3.26±0.02	2.69±0.08
Iron	2.20±0.01	2.83±0.01
Copper	0.44±0.03	0.64±0.04

*Each value represents the average of three determinations

E. Physical properties of selected appe mix powder

The different physical properties including bulk density, tap density, true density, compressibility index, porosity, static friction and angle of repose of the selected (T_3) sample were evaluated and the obtained data summerised in the Table 6.

Data obtained from the Table 5 Showed that the bulk density, tap density and true density of sample were found to be 588, 769 and 1250 $Kg.m^{-3}$ respectively. Density helps in the designing of packaging material and container size. Comressibility index of the sample was 23.53%. Compresibility of powder product determines the appearance of the containers contents upon reaching the consumer. Porosity of the sample was 52.96 %. Static friction and angle of repose was 0.46 and 41.02° respectively. Angle of repose helps in designing the hopper and to measure the powder resistance to flow under gravity.

Table 6: Physical properties of selected appe mix powder (T_3).

Parameters	Values
Bulk density ($Kg.m^{-3}$)	588
Tap density ($Kg.m^{-3}$)	769
True density ($Kg.m^{-3}$)	1250
Compressibility index (%)	23.53
Porosity (%)	52.96
Static friction	0.46
Angle of repose (°)	41.02

F. Reconstitutional properties

The obtained result narrated that the water absorption capacity of appe mix powder was 140%. Wetability of appe mix powder was found to be 55 for 10g/sec. The ratio of appe kix powder to normal water was 1:1.4 and the time required for reconstitution to achieve proper consistency of batter was 38-40 sec by contineous stirring with glass road.

G. Shelf life study of selected appe mix powder

Shelf life of prepared appe mix powder was studied for 75 days at room temperature. The parameters such as weight, moisture content, water absorption capacity and overall acceptability considered. The different packaging materials used for the shelf life study analysis such as HDPE standing pouch, HDPE aluminium laminated standing pouch, PP and PET. The obtained results are summerised in Table 7.

The data obtained from the Table 6 revealed that there is slight increase in the weight of kept sample with increasing days. From the obtained results it was narrated that HDPE aluminium laminated standing pouch found to be best suitable with compare to other. The best sensory score for the product packed in HDPE aluminium laminated standing pouch with overall acceptability score 7.4 after 75 days was found to be acceptable. WAC in first day was 140% and after 75 days it was 141.5 %. The sample kept in PP packaging materials was not acceptable from the study driven. The PET bottles are also acceptable but with compare to cost and all the parameters the HDPE aluminuim laminated standing pouch was found to be significant.

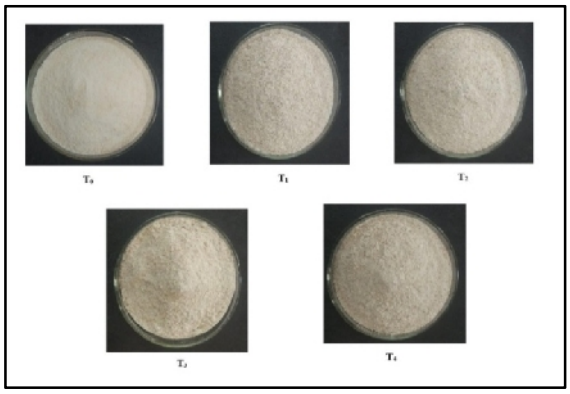

Table 7: Shelf life study of selected appe mix powder.

Days	Parameters				
	Packaging material	Weight (g)	Moisture content (%)	WAC (%)	OAA
0	HDPE Standing pouch	50	5.51	140	8.1
	HDPE Aluminium Standing pouch	50	5.51	140	8.1
	PP	50	5.51	140	8.1
	PET	50	5.51	140	8.1
15	HDPE Standing pouch	50	5.51	140	8
	HDPE Aluminium Standing pouch	50	5.51	140	8.1
	PP	50	5.51	140	8
	PET	50	5.51	140	8.1
30	HDPE Standing pouch	50	5.51	141	7.9
	HDPE Aluminium Standing pouch	50	5.51	140	8
	PP	50.08	5.52	143	7.8
	PET	50	5.51	140	8
45	HDPE Standing pouch	50.09	5.54	143	7.7
	HDPE Aluminium Standing pouch	50.06	5.52	140.8	7.9
	PP	50.12	5.55	145	7.6
	PET	50.04	5.53	140.9	7.9
60	HDPE Standing pouch	50.13	5.59	146	7.4
	HDPE Aluminium Standing pouch	50.07	5.57	141.2	7.7
	PP	50.16	6.01	147	7.5
	PET	50.08	5.5	141.3	7.6
75	HDPE Standing pouch	50.15	6	148	7.1
	HDPE Aluminium Standing pouch	50.09	5.59	141.5	7.4
	PP	50.18	6.12	149	7
	PET	50.1	5.62	141.7	7.2



CONCLUSION

Ingredient composition for the preparation of millet based instant appe mix standardised based on organoleptic evaluation and it was rice 40g, black gram dal 20g, finger millet 20g and foxtail millet 20g. Prepared appe mix powder contains protein (12.04±0.15%), fat (1.46±0.01), carbohydrate (72.4 ±0.01%), crude fibre (3.4±0.01%), ash (3.35±0.01%) and energy (350.92 ±0.73 kcal). The product was found to be good source of mineral such as calcium (102.5±0.98mg), magnesium (104.1±0.98mg) and phosphorus (222.53±1.66mg). The shelf life of the prepared product was established up to 75 days at room temperature. This study has shown that finger millet and foxtail have good potential for use in convenience food product formulation with the objective to enhance nutritional quality to meet future demand.

FUTURE SCOPE

In upcoming days the millet value added food products will helps to provide various health benefits including its nutritional content. So product can be prepared with the addition of other millets such as pearl millet, barnyard millet and great millet. Shelf life could be enhance upto 4-5 months (120-150 days) by keeping the product at refrigerated temperature.

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