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Formulation, development and shelf life assessment of instant soup mix using *Moringa oleifera* flower powder

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Abstract
Among the five combinations (that is Control, MFP1%, MFP2%, MFP3% and MFP4%) MFP 4% shown highest protein content ranged from 9.76-12.93 % and the range of carbohydrates 61.04% against the control 61.52%. The crude fibre content of instant soup mix ranged from 4.13 to 5.11% in various formulation MFP 4 exhibitits maximum fibre content compared to rest. In the next step the sensory attributes during storage of formulated instant soup. The overall activity of control was 8.63 and MFP4 8.08 was decreased gradually up to 8.40 and 7.74 respectively at the end of storage in PP. Moisture content increased gradually from 8.71 to 8.88 in 90 days storage period. Total plate count for 30 days was negligible during storage in alluminium foil and very less count was observed on 90th day of storage in all soup samples.

Keywords: Crude fibre, MFP, Panicle and plate count

Introduction
The Moringa flower is yellowish-white, slender, with hairy stalks in spreading or dropping auxiliary clusters (Panicle). The flower is scented, bisexual and measures about 10-25 centimeters long. Individual flowers are set in a basal cup (Hypanthum) that is 3 millimeters long and are approximately 0.7 to 1 cm long and 2cm broad with five unequal yellowish - white, thinly veined, spatulate petals, five stamens with five smaller sterile stamens (staminode) and a pistil composed of one celled ovary and slender style (Little *et al*., 1964; Ramachandran *et al*., 1980) [22].

Moringa flower contain nine amino acids, sucrose, D-glucose, traces of alkaloid, wax, and is rich in potassium, calcium and some flavonoids pigment (Ruckmani *et al*., 1998, Anwar *et al*., 2007) [24, 4]. It contains pterogospermin, an antibiotic that is highly effective in the treatment of cholera. Moringa flowers were extracted using alcohol and aqueous extract solution and it was discovered that it contains quercitin, a known flavonoids with hepatoprotective activity, which indicates a significant hepatoprotective effects Lizzy *et al*. (1968) [14]. Moringa flowers are used as a tonic and diuretic (Rollof *et al*., 2009) [23], The curative ability of Moringa flower over inflammations, muscle diseases, tumors, and enlargement of the spleen, and ability to reduce serum cholesterol, phospholipids and triglyceride, make it useful for regulation of cholesterol to phospholipids ratio and also as a stimulant and it could be said to be of high medicinal value (Siddhuraju and Becker, 2003; Mehta *et al*., 2003) [25, 16].

Instant soups play an important role in balancing the nutrients required for the people to stay healthy and can become an alternative food for breakfast (Mathangi *et al*. 2017) [15].

Hot soups are boiling solid ingredients in liquids in a pot until the flavors are extracted, forming a broth. Soups play an important role in the nutrition of people because they fulfill present and future social consumer requirements (Kanias, 1991) [11]. Also, they do not need any preservatives or refrigerator to preserve those (Mathangi *et al*. 2017) [15].

Materials and Methods
Moringa leaves powder preparation: Good quality of Moringa flowers were collected from the University Campus and cleaned properly for drying.

Dehydration of Moringa flowers, spices and vegetables: The flowers dried in hot air oven at 55°C for 16 hours as per (Parvathi *et al.*, 2015) [21]. The fresh spices and vegetables were cleaned, chopped into small pieces and dried in hot air oven at 65°C for 5-6 hours.

Preparation of instant soup mix: Several compositions like 0%, 18%, 20%, 22% and 24% of Moringa flower powdered and used for formulations of raw materials and main ingredients were tried to arrive at the desired formulation with optimum percentage as recommended by acceptability studies. All the samples were prepared using the method of Amal *et al.,* (2014) [1] with slight modification various acceptability parameters such as consistency, colour, appearance, flavour, taste, after taste and overall acceptability were considered as deciding factors by using the method described by Amerine *et al.*, (1965) [2].

Physical properties: *Reconstitution Index (RI), Water absorption capacity (WAC)* and *Bulk density (BD) were determined by the method of* Onwuka, (2005) [19]. *Rehydration Ratio (RR)* - was defined as the ratio of weight of rehydrated samples to the dry weight of the sample (Krokida and Kouris, 2003) [13]. *Swelling index (SI)* - The method as described by Ukpabi and Ndimele (1990) [26] was used in the determination of the swelling index. *Hunter Colour Measurement*- Colour measurement of different instant soup mixes was done by using a Hunter colour measuring system and expressed in terms of L*, a*, b*, according Kramer, 1976) [12].

Chemical properties: All the experiments were carried out in duplicate and mean values have been reported. The instruments used were properly calibrated and standardized procedures were followed for the valid and reliable analysis.

Proximate composition of instant soup mix The nutritional evaluation of instant soup mix with respect to various constituents was carried out by the following procedures. *Determination of Moisture content*- The moisture content of the sample was determined by using moisture meter. *Determination of Protein content, Fat content, Ash content and crude fibre* was determined by the method as described in AOAC (1992) [5]. And *Determination of Total Carbohydrates* was estimated by the method Merrill and Watt, (1973) [17].

Storage studies: - The storage stability of instant soup mix was carried out using Low Density Polyethylene (LDPE), Polypropylene (PP) and Aluminium foil pouches for a period of 3 months at ambient conditions. All the samples were drawn periodically after 0, 30, 60, 90 days and analyzed for sensory qualities, moisture, microbial count and hunter colour analysis. The total plate count was done by using the method of Aneja, (2003) [3].

Sensory analyses: The sensory quality characteristics were evaluated by Amerine *et al.* (1965) [2].

Statistical analysis- A complete randomized design was adopted for statistical study of data by following the procedure as described by Panse and Sukhatme (1985) [20].

Result and Discussion

The present study showcases a comprehensive investigation on flower of *Moringa oleifera*. It was investigated to test the suitability of Moringa flower with other ingredients to prepare instant soup mix.

A number of trials were conducted by taking varying Moringa flowers, sugar, corn starch, cumin, black pepper, salt, green pea, cabbage, carrot, coriander, garlic, onion, tomato, lentil, sanwa millet, citric acid and sodium benzoate. Accordingly soup was prepared using earlier mentioned basic recipe for soup with 10 to 30% Moringa parts, 10- 38% lentil, 2 to 5% salt and sugar, 7 to 10% cornstarch. Finally soup were prepared using the optimum level of ingredients arrived at desired formulations from the earlier results of acceptability studies of soup formulations. The findings of Farzana et. al. 2017 [9] and Olaitan *et al*. 2014 [18] are in contrast with the present investigation.

Physical attributes of instant soup mixes with Moringa flower powder: ***Reconstitution Index:*** Similar findings were reported by Amal *et al*. 2014 [1]. The observed Reconstitution Index with different combinations of instant soup mix varied from 14.30 to 16.33 (g/ml) in Moringa leaf powder. The Reconstitution Index in Moringa flower instant soup mix it was highest in MFP4 (17.3 g/ml) and lowest in control (14.30 g/ml) whereas in pod powder soup mix, (Table 2.0).

Water absorption capacity: In Moringa flowers instant soup mix, the WAC ranged from 250 to 290 ml/100g. The highest value of WAC is found in control (290 ml/100 g) followed by MFP4 (260 ml/100 g) and lowest value in MFP1 (250ml/100 g). (Table 2.0).

Bulk Density: The bulk density of instant mixes ranged from 0.72 to 0.80 g/ml in Moringa leaf powder, 0.59 - 0.72 to g/ml in instant soup mix with Moringa flower powder. Significantly lower bulk density was observed in soup mixes of MFP. (Table 2.0).

Rehydration ratio: The rehydration ratio with Moringa flower powder method of instant soup mix varied from 2.5 to 4.36 which were highest in MFP3 and lowest in control. Table (2.0).

Swelling index: The Swelling index with different combinations of instant soup mix (Table 2.0) in Moringa flower instant soup mix, swelling index was highest in MFP4 (1.50) and lowest in control (1.33).

Hunter colour analysis of instant soup mixes with Moringa flower powder: Colour of the food is the first parameter of quality evaluated by consumers. Although there are many different colour, the most frequently used is the hunter L* a* b* colour, due to its uniform colour distribution and because its perception of colour is closest to the one human eye. Instant soup mixes from MFP showed highest value of lightness in control followed by MFP1 (63.43), MFP3 (61.25), MFP4 (60.36) and the lowest value (58.56) was obtained from MFP2. The highest a* and b* values of soup obtained from control and lowest from MFP1 viz. 6.12 and 13.87 respectively. (Table 3.0).

Proximate analysis of instant soup mixes with Moringa flower powder: Moisture content varied from 8.41 to 8.62 percent as shown in the (Table 4.0). MFP4 exhibited maximum moisture content followed by MFP3, MFP2, MFP1 and control formulation with minimum moisture content. It is clear from table 4.0, that protein ranged from 9.76 to 12.93 percent in different formulations of instant soup mix. Formulation MFP4-22% (12.93) had significantly maximum protein content followed by MFP3, MFP2, MFP1 and control with the minimum protein content. All formulations differed significantly from each other. The range of fat content was found to be 1.40 to 2.52 percent in various instant soup mix formulations. MFP4 exhibited maximum fat content as

compared with other formulations and it was statistically superior to rest. The original instant soup mix (control) exhibited highest carbohydrate content (61.52%) followed by MFP4, MFP3, MFP2, and MFP1 with lowest content. Control was statistically superior to other formulations. The crude fibre content of instant soup mix ranged from 4.13 to 5.11 percent in various formulations. MFP4 exhibits maximum fibre content compared to the rest; hence it is statistically superior to other formulations. The ash content in different blends of instant soup mix ranged from 8.69 to 9.93 percent. MFP4 was numerically superior to rest of the formulations and at par results were reported by Farzana *et al*. (2017) [9], Ewulo *et al* 2017 [8], Debebe and Mulugeta 2017 [7].

Sensory attributes of instant soup mix during storage with Moringa flower powder: ***Colour and appearance*****:** The score for colour and appearance in the present investigation of instant soup mix as influenced by storage temperature and period is presented in Tables 5.0. The initial values of colour and appearance were recorded by treatment CONT (8.67) and were gradually decreased up to 8.40 on 90th day of storage and treatment MFP4 (8.00) was decreased upto 7.76 in PP at the end of storage.

Flavour: The data on the changes in the flavour score of instant soup mix as influenced by treatments and storage period are presented in Table 5.0. The data revealed that flavour of instant soup mix had an initial value of 8.50 (CONT) which was decreased gradually up to 8.42 in PP on 90th days of storage. The modified soup mix MFP4 was decreased from 8.06 to 7.82 in PP at the end of storage. ***Taste-*** The data presented in Table 5.0 revealed that there was slightly decreasing trend in score card for taste among all the treatments. The taste of CONT (8.66) was decreased up to 8.36 in PP on 90th day of storage and treatment MFP4 (8.03) was decreased up to 7.80 in PP at the end of storage.

Consistency: A slight decreasing trend in consistency of soup was observed among all the treatments during storage. The mean value of the CONT and MFP4 was 8.90 and 8.07 respectively at initial stage and was decreased during the period of storage upto 8.60 and 7.73 respectively in PP on 90th day of storage.

After taste: Decreasing trend in after taste of soup was observed among all the treatments during storage. The mean value of the CONT and MFP4 was 8.76 and 8.08 respectively at initial stage and was decreased during the period of storage upto 8.50 and 7.67 respectively in PP on 90th day of storage.

Overall acceptability: The data regarding the overall acceptability of instant soup mix is presented in Table 5.0. It is observed from the data that there was a significant difference among the all packaging materials. The scores of CONT (8.63) and MFP4 (8.08) was decreased gradually up to 8.40 and 7.74 respectively at the end of storage in PP. Similar findings of supplementation were reported by Amal et. al. 2014 [1] and Babayeju et. al. 2014.

Moisture content of instant soup mixes during storage: Results indicated that the slight increase was observed in moisture content of the instant soup mixes during storage in all the packaging materials. The data revealed that moisture content of instant soup mixes (control) had an initial value of 8.41 percent which was increased gradually up to 8.64 in PP at the end of storage and in modified instant soup mixes, it ranged from 8.71 - 8.88 for MFP4 packed in PP at the end of storage.

Hunter colour analysis of instant soup mixes during storage: As per Table- 7.0 the Hunter colour values of different instant soup mixes were found to be slightly changed during storage upto 90 days in all packaging materials. The colour retention was more in Aluminium foil bags during storage in all soup samples.

Total plate counts of instant soup mixes during storage: Instant soup mixes were stored for 90 days at ambient temperature in different packaging materials. The results of microbial analysis showed increase in total plate count during storage but it was found to be under acceptable limit. The total plate count found negligible up to 30 days of storage of instant soup mixes packed in aluminium foil and very less count was observed on 90th day of storage in all soup samples. The total plate count was too less to count in all packaging materials on 0 day of storage. The yeast and mold counts were absent during storage. The close context found in the work of Jay (1992) [10] that product is microbiologically safe if the total microbial count of dehydrated soups is <1x104cfu/g.

Table 1: Different Treatment combinations of instant soup mix with Moringa flower powder

Formulations	Control	MFP %	MFP %	MFP %	MFP %
Citric acid	0.25	0.25	0.25	0.25	0.25
Sodium benzoate	0.30	0.30	0.30	0.30	0.30
Sugar	4	4	4	4	4
Corn starch	8	8	8	8	8
Cumin	0.3	0.3	0.3	0.3	0.3
Black pepper	0.5	0.5	0.5	0.5	0.5
Salt	4	4	4	4	4
Green pea	4	4	4	4	4
Cabbage	0.3	0.3	0.3	0.3	0.3
Carrot	4	4	4	4	4
Coriander	0.35	0.35	0.35	0.35	0.35
Garlic	1.30	1.30	1.30	1.30	1.30
Onion	2	2	2	2	2
Tomato	10	10	10	11	11
Lentil	35	19	17	15	13
Sanwa millet	25	25	25	24	24
MLP	0	16	18	20	22
Total	100	100	100	100	100

MFP= Moringa flower powder

Table 2: Physical attributes of instant soup mixes with Moringa flower powder

Formulations	Reconstitution Index (g/ml)	WAC (ml/ 100g)	Bulk density (g/ml)	Rehydration ratio	Swelling Index
CONT	14.30	290	0.72	2.5	1.33
MFP1	14.33	250	0.57	4.2	0.66
MFP2	15.8	253	0.58	3.7	0.66
MFP3	16.6	255	0.55	4.6	1.5
MFP4	17.33	260	0.59	4.33	1.33
SEM	0.513	0.856	0.008	0.316	0.087
C.D.at 5%	1.636	2.733	0.026	1.008	0.277

WAC= Water absorption capacity

Table 3: Hunter colour analysis of instant soup mixes with Moringa flower powder

Formulations	L*	a*	b*
CONT	75.12	9.42	15.69
MFP1	63.43	6.12	13.87
MFP2	58.76	8.25	15.6
MFP3	61.25	7.10	14.57
MFP4	60.36	6.82	14.65
SE(m)	0.687	0.537	0.378
C.D.	2.192	1.714	1.207

Table 4: Proximate analysis of instant soup mixes with Moringa flower powder

Formulations	Moisture (%)	Protein (%)	Fat (%)	Crude fibre (%)	Carbohydrate (%)	Ash (%)
CONT	8.41	09.76	1.40	4.13	61.52	8.69
MFP 1	8.46	12.22	2.22	4.85	58.33	9.76
MFP2	8.49	12.43	2.32	4.94	59.18	9.28
MFP3	8.53	12.84	2.42	5.03	60.03	9.77
MFP4	8.62	12.93	2.52	5.11	61.04	9.93
SEM	0.034	0.285	0.144	0.143	0.668	0.094
CD at 5%	0.108	0.909	0.460	0.456	2.132	0.301

Table 5: Sensory attributes of instant soup mix during storage (with Moringa flower powder)

Attributes	Aluminium foil							
	0 days		30 days		60 days		90 days	
	CONT	MFP4	CONT	MFP4	CONT	MFP4	CONT	MFP4
Colour & appearance	8.67	8.00	8.67	8.00	8.67	8.00	8.62	7.84
Flavour	8.50	8.06	8.50	8.06	8.50	8.06	8.50	8.00
Taste	8.66	8.03	8.66	8.03	8.66	8.03	8.55	7.96
Consistency	8.90	8.07	8.90	8.07	8.90	8.07	8.84	8.00
After taste	8.76	8.08	8.76	8.08	8.76	8.08	8.70	8.00
Over all acceptability	8.63	8.08	8.63	8.08	8.63	8.04	8.60	8.00
LDPE								
Colour & appearance	8.67	8.00	8.60	7.90	8.55	7.86	8.45	7.80
Flavour	8.50	8.06	8.40	7.98	8.46	7.96	8.48	7.88
Taste	8.66	8.03	8.62	7.90	8.55	7.88	8.42	7.85
Consistency	8.90	8.07	8.88	7.80	8.75	7.90	8.67	7.80
After taste	8.76	8.08	8.67	7.86	8.62	7.78	8.56	7.74
Over all acceptability	8.63	8.08	8.62	8.04	8.60	8.02	8.54	7.92
PP								
Colour & appearance	8.67	8.00	8.57	7.85	8.50	7.80	8.40	7.76
Flavour	8.50	8.06	8.38	7.82	8.43	7.82	8.42	7.82
Taste	8.66	8.03	8.50	7.86	8.41	7.80	8.36	7.80
Consistency	8.90	8.07	8.78	7.83	8.70	7.85	8.60	7.73
After taste	8.76	8.08	8.60	7.80	8.56	7.70	8.50	7.67
Over all acceptability	8.75	8.05	8.56	8.00	8.50	7.80	8.40	7.74

Table 6: Moisture content of instant soup mixes during storage

Treatments	Moisture			
	0 days	30 days	60 days	90 days
AL CONT	8.41	8.44	8.47	8.50
ALMFP4	8.71	8.72	8.76	8.78
LD CONT	8.41	8.47	8.52	8.58
LDMFP4	8.71	8.77	8.78	8.80
PPCONT	8.41	8.49	8.55	8.64
PPMFP4	8.71	8.79	8.85	8.88

Table 7: Hunter colour analysis of instant soup mixes during storage

Formulations	0 day			30 day			60 day			90 day		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
ALCONT	75.12	9.42	15.69	75.12	9.42	15.69	74.12	8.42	14.60	73.11	8.22	14.49
ALMFP4	60.36	6.82	14.65	60.36	6.82	14.65	60.24	6.80	14.52	60.06	6.72	14.44
LDCONT	75.12	9.42	15.69	75.12	9.42	15.69	73.90	8.32	14.49	72.90	8.10	14.40
LDMFP4	60.36	6.82	14.65	60.36	6.82	14.65	60.19	6.72	14.29	59.98	6.62	14.28
PPCONT	75.12	9.42	15.69	75.12	9.42	15.69	73.82	8.26	14.40	72.82	8.00	14.38
PPMFP4	60.36	6.82	14.65	60.36	6.82	14.65	60.00	6.66	14.22	59.96	6.60.	14.24

Table 8: Total plate counts of instant soup mixes during storage

Treatment	Mesophilic count			
	0 days	30 days	60 days	90 days
PPCON	TFTC	$1.3X10^2$	$2.2X10^3$	$3.2X10^3$
PPMFP	TFTC	$1.3X10^2$	$2.2X10^3$	$2.6X10^3$
LDCON	TFTC	$1.3X10^2$	$2.2X10^3$	$3.8X10^3$
LDMFP	TFTC	$1.3X10^2$	$2.2X10^3$	$3.1X10^3$
ALCON	TFTC	$1.3X10^2$	$2.2X10^3$	$2.1X10^3$
ALMFP	TFTC	TFTC	$1.4X10^2$	$2.2X10^3$

TFTC= Too few to count

Conclusion

The results of this study clearly demonstrated the usefulness of supplementing soup mix with Moringa flower as a valuable food addition to enhance nutritional characteristics of the instant soup. The developed instant medicinal soup mixes have an acceptable sensory, nutritional and microbial quality and it can be stored in Aluminium foil up to 3 months under ambient conditions without affecting the quality attributes. The soup mix being a novel one holds good commercialization potential.

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