International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

DEVELOPMENT OF INSTANT SOUP MIXUSINGMORINGA LEAVES ANDBANANA PSEUDOSTEM

Jefrin. A, Kishore Fathima. I, Sowbarnika. B
B.Tech in Food Technology
College of Fish Nutrition and Food Technology
Chennai, Tamilnadu, India

Brimapureeswaran. R
Assistant Professor
College of Fish Nutrition and Food Technology
Chennai, Tamilnadu, India

Usha Antony
Dean
College of Fish Nutrition and Food Technology
Chennai, Tamilnadu, India

Abstract-**Moringa oleifera is an underexploited perennial vegetable species of moringaceae family. It is rich in nutrients, vitamins and minerals and have been shown to have positive health benefits. The Moringa oleifera leaves can be eaten as a vegetable but cannot be stored for a longer time. Hence, they are dried and converted into powder for longer storage. But the usage of dried Moringa oleifera leaves powder are restricted due to its unpleasant and bitter taste. Similarly, banana center core also known as pseudo stem, a biologically waste material in banana plantations could be effectively utilized as a source for incorporation in formulated products by converting them into powder. Considering these issues an attempt was made to formulate instant soup mix using varying ratios of Moringa oleifera leaves powder and banana pseudo stem powder along with dried spices such as onion, garlic, turmeric and black pepper. On subjecting moringa leaves to different drying methods, leaves dried at 60 ^{0} C in a tray dryer retained higher amount of nutritional value. Similarly, pseudo stem when dried at 70 ^{0} C in a tray dryer proved to be the best in terms of nutritional value. Using these, the soup mix was formulated with various ratios of moringa leaves powder and banana pseudo stem powder. The proximate composition revealed that the soup mix was high in protein (28.42%), ash (9.564%), fiber (10.613%) and low in fat (2.468%) and carbohydrates (44.405%). The soup mix was accepted by consumers with a sensory score of 4.00 out 5 in a hedonic scale and the soup mix was free from microbial contamination. The developed instant soup mix as an appropriate choice for fulfilling the nutritional demand of people.**

Keywords- **Moringa leaves, Banana pseudostem, Spices, Tray dryer, Soup mix,**

I. INTRODUCTION

Moringa oleifera (Moringaceae) is traditionally known as mystical miracle tree or 'The tree of life'. The leaves being the most nutritious part of the plant is a significant source of protein, fat, calcium, iron, copper, zinc, manganese and have high levels of Vitamin B, C, K and β-Carotene. Moringa oleifera is one of the best examples, which contains all essential nutrients, enzymes, omega oils, minerals, antioxidants and phyto-chemical compounds. The fresh Moringa oleifera leaves contain seven times more Vitamin C than in orange, four times more calcium than in milk, three times more iron than in spinach, three times more potassium than in banana, four times more Vitamin A than in carrot and proteins as much as in egg (Ansari et al. 2020). Banana is an important fruit crop grown mainly in tropical and sub-tropical areas. Musa acuminata and Musa balbisiana are two wild species of banana cultivated largely for its seedless property (Raju et al. 2019). Banana pseudostem appears to be a rich in source of fibre, total carbohydrate and cellulose (Saravanan et al. 2011). They help to control obesity and detoxifies the body. It is consumed as fresh juice to prevent kidney stones and also relieves constipation (Dawn et al. 2016). It is also found to be rich in potassium and Vitamin B6. Banana pseudostem

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

flour (BPF) has good amount of several important macro minerals potassium (K), sodium (Na), calcium (Ca), magnesium (Mg) and phosphorus (P) which is important to maintain body health. Banana pseudostem flour exhibits high fibre (Ho et al. 2015). In order to utilize banana pseudostem, it has to be processed to be incorporated into food products to increase its value, including both nutritional and sensory characteristics (Thorat and Bobade 2018). The processing of banana pseudostem into flour can provide a means for prolonging its shelf life and also prevent the spoilage.

Soup is generally prepared by combining ingredients such as vegetables, green leaves, water or other liquid. Usually there are two kinds of soups like thick soup and clear soup. In the modern world, commercially prepared instant soup has replaced homemade soup, as preparing a soup is a time-consuming process (Niththiya et al. 2014). Instant soup plays an important role in balancing the nutrients required for the people to stay healthy and can become an alternative food for breakfast (Sudarsan et al. 2016). In addition to that, they are ready for reconstitution in a short time.

II. MATERIALS AND METHODS

A. Collection of samples

Fresh moringa leaves, were collected from the Kulla Govinthan street at Madhavaram milk colony, Chennai beside our college campus and the fresh banana pseudostem of Musa acuminata variety (about 3 ½ kg) were procured from the local market of Madhavaram milk colony, Chennai, Tamilnadu.

B. Processing Techniques

Preparation of Moringa Leaves Powder

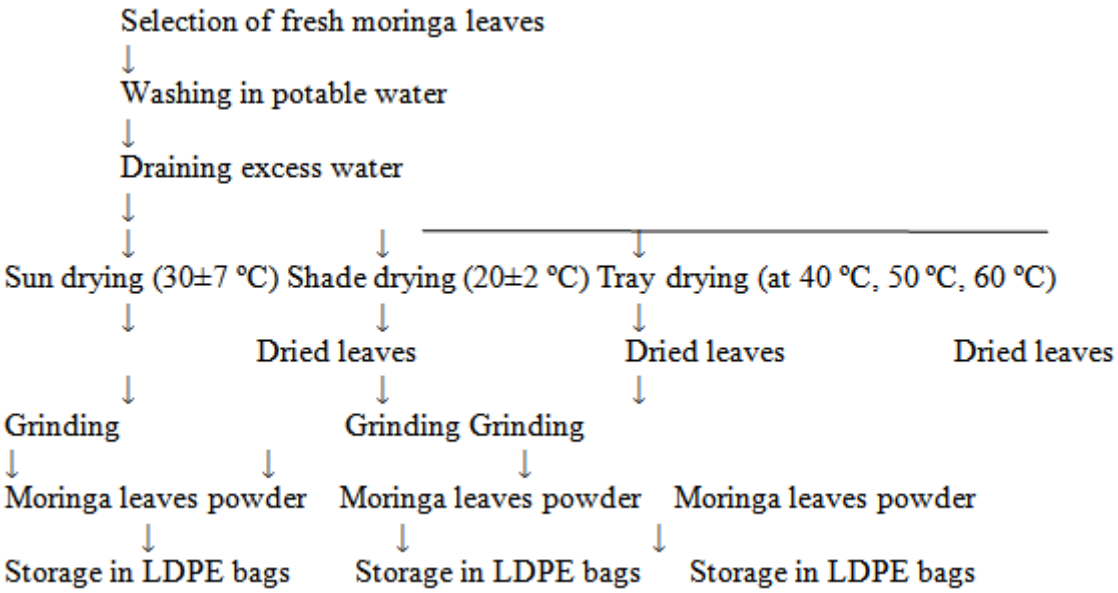

Fig. 1. Flow chart for preparation of Moringa Leaves Powder

(a) (b) (c)

Fig. 2. (a) Fresh Moringa leaves (b) Cleaned and washed leaves (c) Moringa Leaves powder

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

Preparation of Banana Pseudostem Powder

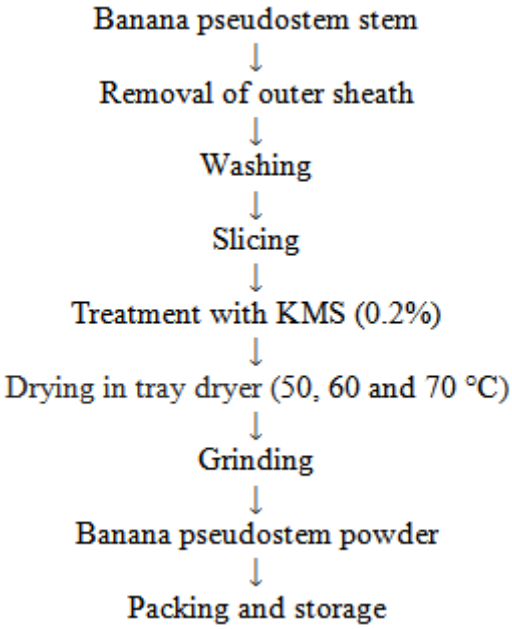

Fig. 3. Flow chart for preparation of Banana Pseudostem Powder

(a) (b) (c)

Fig. 4. (a) Sliced Banana Pseudostem (b) Soaking in KMS (c) Banana PseudostemPowder

Preparation of Garlic, Onion and various spice powders

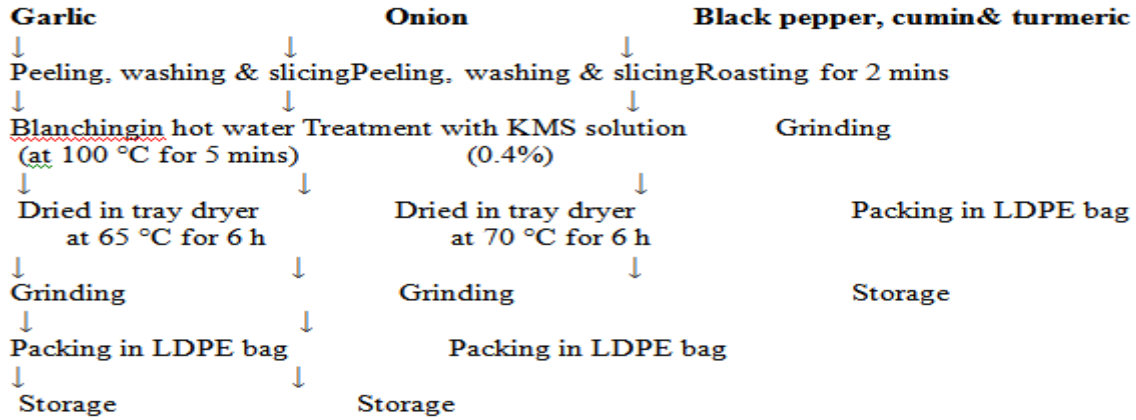

Fig. 5. Flow charts for preparation Garlic, Onion and various Spice Powders

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

Table- 1 Formulation of instant soup mix

Ingredients	**C* (%)**	**F_1 (%)**	**F_2 (%)**	**F_3 (%)**
Moringa leaves powder	71.42	35.71	23.81	47.61
Banana pseudostem powder	0	35.71	47.61	23.81
Onion powder	5.72	5.72	5.72	5.72
Garlic powder	2.86	2.86	2.86	2.86
Turmeric powder	0.95	0.95	0.95	0.95
Pepper powder	9.53	9.53	9.53	9.53
Cumin powder	2.38	2.38	2.38	2.38
Salt	7.14	7.14	7.14	7.14
Total	100	100	100	100

(Moringa powder: Pseudostempowder) C*- Control (1:0); F_1- (1:1); F_2- (1:2); F_3- (2:1)

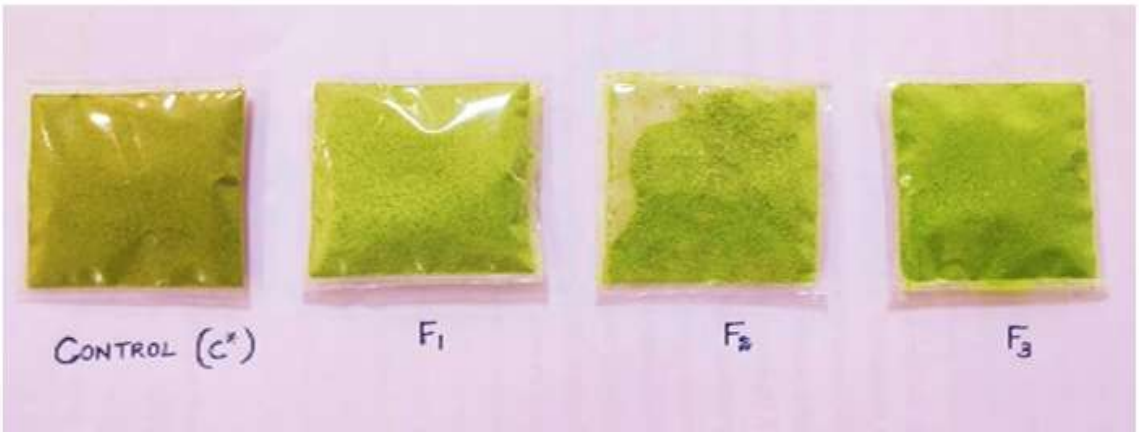

Fig. 6. Formulated instant soup mixes

Preparation of soup with soup mix

To prepare soup using the formulated mix, add a tea spoon of soup powder in a 200ml of water. Boil the soup powder for 10 minutes and serve

Proximate analysis

Prepared Moringa oleifera leaves powder, banana pseudo stem powder and formulated instant soup mixes were analysed for its proximate composition using AOAC (2006) method. The following parameters such as moisture content, protein, crude fat, crude fibre, crude ash and carbohydrate. Moisture content- The moisture content was determined by using Hotair oven. Protein content- The protein content was determined by usingkjeldhal principle in Kel plus apparatus as given in AOAC(2006). Fat content- The fat content was determined by using Socs plus apparatus as described in AOAC (2006). Ash content- The ash content was determined by using Muffle furnace. Fibre content- The fibre content was determined by using Fibra plus as described in AOAC (2006). Carbohydrate content- Total carbohydrate was estimatedby subtracting the sum of moisture, protein, fat, ash and fibre from 100 (Merrill and Watt, 1973).

Physical properties

pH- It was determined using pH meter and was standardized with distilled water of pH 7.0. Total soluble solids (TSS)- About 2 g of sample was taken and stirred in 50 ml of water. The content was filtered and using a handheld refracto meter, the TSS was determined. This is expressed as degree brix (Tiroutchelvame et al. 2019). Bulk density and true density- This was determined by the method followed by (Akpapuimam and Markakis, 1981). Bulk density is the ratio between mass and volume of a freely poured powder in a container and true density is the ratio of the mass of the control and the formulated samples to the volume of the sample without pore space. Hausner ratio- It is an indicator of flowability of bulk solids. The lower the Hausner ratio, more flowable the product (Hausner, 1967). Carr index- It is an indicator of flowability of bulk solids. The lower the Carr index, more flowable the product (Carr, 1965). Water holding and Oil absorption capacity- This was determined based on standard procedures of (Gould et al. 1989). Rehydration ratio- It is defined as the ratio of weight of rehydrated samples to the dry weight of the sample (Krokida

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

and Kouris, 2003). Swelling index- It was measured using the method of Ukpabi and Ndimele, (1990).

Microbiological analysis
The microbial analysis such as total plate count, coliform count and yeast and mould count of the formulated samples was enumerated by the method of IS 5204:1969.

Sensory analysis
The sensory attributes such as appearance, odour, flavour, taste, consistency and overall acceptability were evaluated using 5-point hedonic scale. The formulated instant soup mix samples were prepared as a soup by boiling in water and the sensory evaluation was performed at College of Fish Nutrition and Food Technology, Chennai 51. Fifty non trained panellists were involved in this sensory evaluation.

III. EXPERIMENT AND RESULT

A.Proximate composition of moringa leaves powder
The moisture content ranged from 4.32 to 8.56%. the highest was observed in shade dried sample (8.56%) and the lowest was observed in sun drying (4.32%). The protein content was higher in sample dried in tray dryer at 60 ºC (30.93%) and the lowest was observed in sample dried in tray dryer at 40 ºC (26.56%). The fat content was higher in sample dried in tray dryer at 40 ºC (3.61%) and the lowest was observed in sample dried in tray dryer at 60 ºC (2.60%). The carbohydrate content was higher in sample dried by sun drying (40.27%) and the lowest was observed in sample dried by shade drying (34.12%). The ash content was higher in sample dried by shade drying (8.56%) and the lowest was observed in sample dried in tray dryer at 40 ºC (7.55%). The fibre content was almost similar and the highest was observed in sample dried in tray dryer at 60 ºC (18.76%) and the lowest was observed in sample dried by sun drying (17.12%).

B. Proximate composition of banana pseudostem powder
The moisture content was highest when dried in a tray drier at 50 ºC (6.47%) and lowest when dried in a tray drier at 70 ºC (6.02%). The protein content was highest when dried in a tray drier at 70 ºC (4.10 %) and lowest when dried in a tray drier at 60 ºC (3.96%). The fat content was highest when dried in a tray drier at 50 ºC (1.63 %) and lowest when dried in a tray drier at 60 ºC (1.32%). The carbohydrate content was highest when dried in a tray drier at 50 ºC (63.1%) and lowest when dried in a tray drier at 50 ºC (10.92%). The ash content was highest when dried in a tray drier at 70 ºC (61.70 %) and lowest when dried in a tray drier at 50 ºC (10.92%). The fiber content was highest when dried in a tray drier at 70 ºC (14.92%) and lowest when dried in a tray drier at 50 ºC (13.86%).

C. Development and optimization of instant soup mix
Moringa leaves when dried in a tray dryer at 60 ºC for 8 hours retained higher amount of protein and less amount of fat. Banana pseudostem when dried in tray dryer at 70 ºC, had low moisture, high protein and high fibre. Hence these were used for formulation of instant soup mix. A number of trials were conducted by taking varying moringa leaves powder and banana pseudostem powder pepper, salt, turmeric, garlic and onion powder. Accordingly, the soup was prepared by using the optimum level of ingredients arrived at desired formulations from the earlier results of acceptability studies of soup formulations as mentioned in Table 1. The score for the product F_1 with 35-36 % of moringa leaves powder, 35-36 % of banana pseudostem powder, 5-6 % of onion powder, 2-3% of garlic powder, 0.5-1.0 % of turmeric powder, 9-10% of pepper powder, 2-3% of cumin powder and 7-7.5% of salt were acceptable in terms of all sensory attributes.

D. Physical properties of instant soup mix
pH: -The observed pH of different combinations of instant soup mix ranged from 5.43-5.56 were higher in F_3 (5.56) and lowest in control (5.43) (Table). **TSS: -** The TSS of different combinations of instant soup mix ranged from 1.00-5.00 and the highest was observed in control (5.00 ºbrix) and the lowest was observed in F_3 (5.00 ºbrix). **Bulk density: -** The bulk density of different combinations of instant soup mix ranged from 0.37 – 0.42 g/ml and the highest was observed F_2(0.42 g/ml) and the lowest was observed in F_3 (0.37 g/ml).**Tapped density: -** The tapped density of different combinations of instant soup mix ranged from 0.55 – 0.61 g/ml and the highest was observed F_2 (0.61 g/ml) and the lowest was observed in F_1 (0.55 g/ml). **Carr index: -** The carr index of different combinations of instant soup mix ranged from 26.96 – 34.42 % and the highest was observed F_2 (34.42 %) and the lowest was observed in F_1 (26.96 %). **Hausner ratio: -** The hausner ratio of different combinations of instant soup mix ranged from 1.37-1.51 and the highest was observed F_3 (1.51) and the lowest was observed in F_1 (1.37).**Water holding capacity: -** The water holding capacity of different combinations of instant soup mix ranged from 24.33- 25.97 g/g and the highest was observed F_1 (25.97 g/g) and the lowest was observed in F_2(24.33 g/g).**Oil absorption capacity: -**The oil absorption capacity of different combinations of instant soup mix ranged from 0.56-1.00 ml/g and the highest was observed F_3 (1.00 ml/g) and the lowest was observed in control(0.56 ml/g). **Rehydration ratio: -** The rehydration ratio of different combinations of instant soup mix ranged from 3.37-3.60 and the highest was observed control (3.60) and the lowest was observed in F_2 (3.37). **Swelling index: -** The swelling index of different combinations of instant soup mix ranged from 1.20-1.72 and the highest was observed F_2 (1.72) and the lowest was observed in control (1.20).

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

E. Proximate analysis of formulated instant soup mixes

The moisture content of soup mixes ranged from 4.07 to 5.37% the highest was observed in F_2 (5.37%) and the lowest was observed in control (4.07 %). The protein content ranged from 12.75-30.51 % and was higher in control (30.51 %) and the lowest was observed in F_2 (12.75%). The fat content ranged from 1.84-2.64% and was higher in control (2.64%) and the lowest was observed in F_2 (1.84%). The carbohydrate content ranged from 35.35 - 53.06% was higher in F_2 (53.06%) and the lowest was observed in control (35.35 %). The ash content ranged from 8.36 -10.10% and was higher in F_1 (10.10%) and the lowest was observed in control (8.36%). The fibre content ranged from 10.61 - 19.08 % and was highest in control (19.08%) and the lowest was observed in F_3(10.61%).

F. Sensory attributes

The results of sensory analysis are given in Fig 11. The F_1 got the highest value followed by F_2, F_3 and control. The sensory scores for F_1 in colour, appearance, taste, aroma, flavour, consistency and overall acceptability are 3.90, 3.80, 4.00, 3.60, 3.80, 3.90 and 4.00 respectively. The scores for the control remained low in all the aspects of colour, appearance, taste, aroma, flavour, consistency and overall acceptability as 2.80, 2.50, 2.20, 1.70, 1.50, 2.00, 2.00 respectively.

Drying characteristics

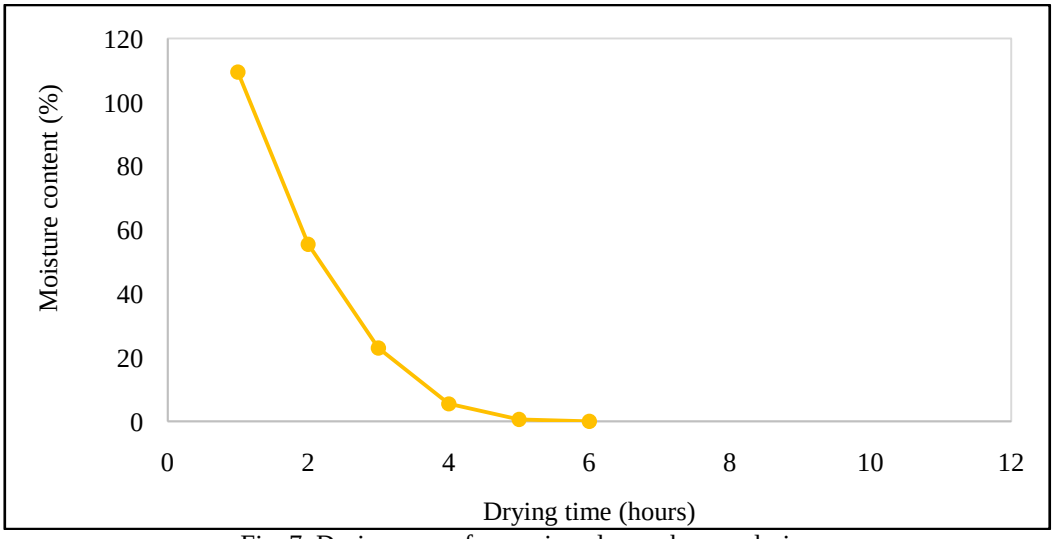

Fig. 7. Drying curve for moringa leaves by sun drying

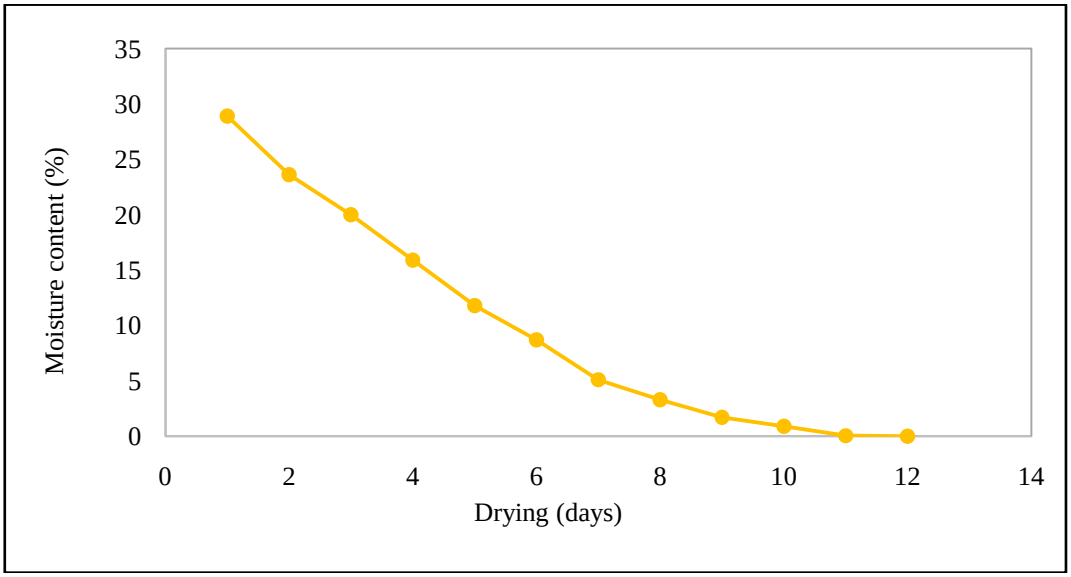

Fig. 8. Drying curve for moringa leaves by shade drying

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

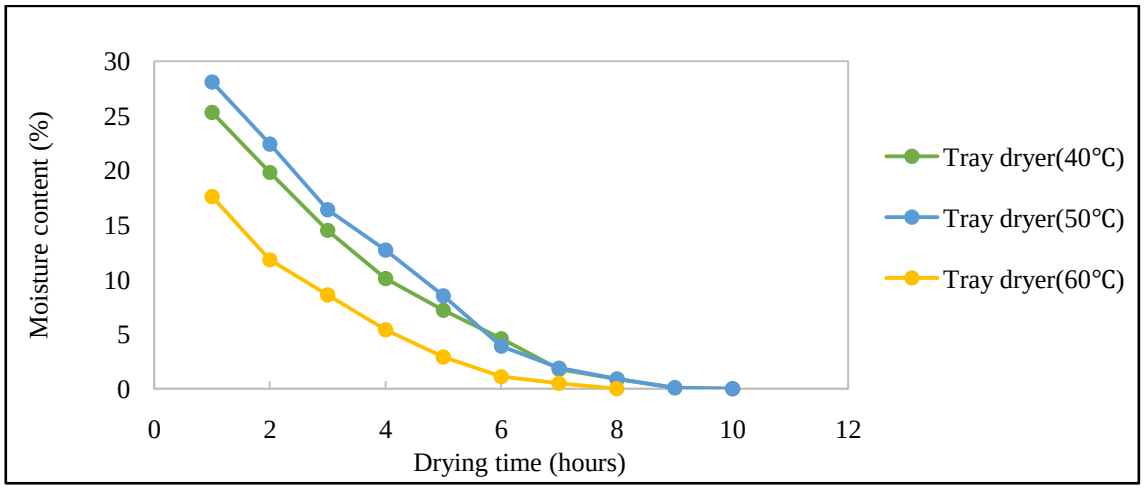

Fig. 9. Drying curve for moringa leaves by tray drying at various temperatures

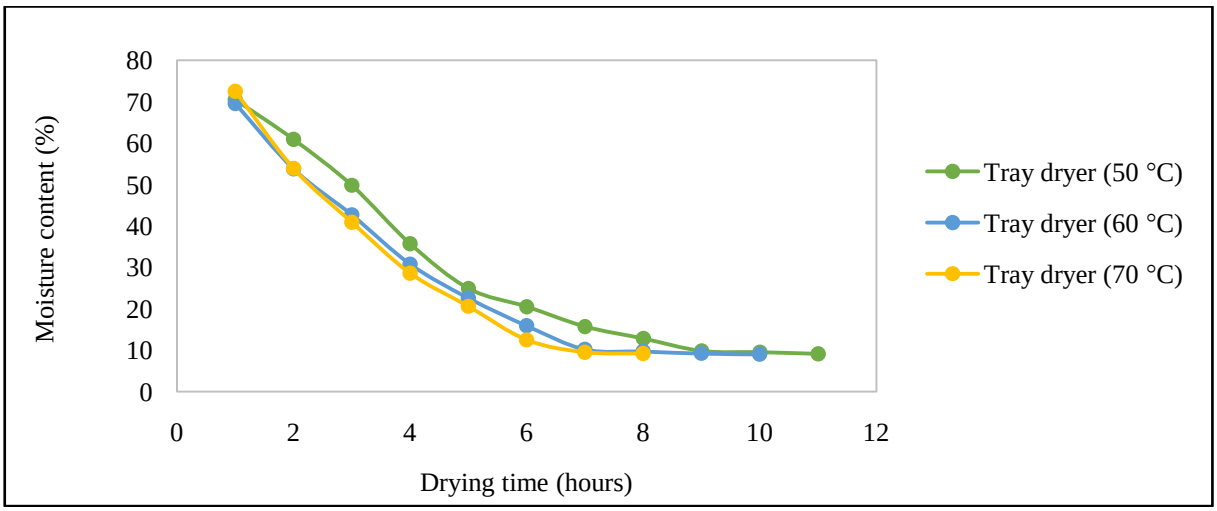

Fig. 10. Drying curve for banana pseudo stem by tray drying at various temperatures

Proximate analysis

Table –2 Proximate composition of moringa leaves powder dried at various temperatures

Proximate composition	**Sun drying**	**Shade drying**	**Tray dryer (40 °C)**	**Tray dryer (50 °C)**	**Tray dryer (60 °C)**
Moisture (%)	4.32±0.06	8.56±0.05	4.9±0.03	5.32±0.03	4.72±0.04
Protein (%)	27.51±0.08	27.62±0.04	26.56±0.04	28.43±0.04	30.93±0.03
Fat (%)	2.82±0.03	3.05±0.04	3.61±0.04	2.92±0.03	2.60±0.03
Carbohydrates (%)	40.27±0.08	34.12±0.04	39.04±0.04	37.21±0.05	34.77±0.03
Ash (%)	7.96±0.09	8.56±0.04	7.55±0.04	8.01±0.04	8.22±0.04
Fibre (%)	17.12±0.09	18.09±0.03	18.34±0.04	18.11±0.04	18.76±0.03

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

Table – 3 Proximate composition of banana pseudostem powder dried at various temperatures

Proximate composition	**Tray dryer (50 ºC)**	**Tray dryer (60 ºC)**	**Tray dryer (70 ºC)**
Moisture (%)	6.47±0.02	6.32±0.02	6.02±0.02
Protein (%)	4.02±0.02	3.96±0.02	4.10±0.02
Fat (%)	1.63±0.03	1.32±0.02	1.44±0.02
Carbohydrates (%)	63.10±0.02	62.12±0.02	61.70±0.02
Ash (%)	10.92±0.03	11.96±0.02	11.82±0.02
Fibre (%)	13.86±0.02	14.32±0.02	14.92±0.02

Table – 4Proximate composition of instant soup mix formulated using different ratio

Proximate composition	**Control (C*)**	**F_1**	**F_2**	**F_3**
Moisture (%)	4.07±0.03	5.04±0.03	5.37±0.03	4.53±0.03
Protein (%)	30.51±0.03	17.17±0.03	12.75±0.03	28.42±0.04
Fat (%)	2.64±0.04	2.03±0.03	1.84±0.03	2.47±0.03
Carbohydrates (%)	35.35±0.03	48.67±0.03	53.06±0.03	44.40±0.03
Ash (%)	8.36±0.03	10.10±0.02	10.69±0.03	9.56±0.03
Fibre (%)	19.08±0.02	16.99±0.03	16.30±0.03	10.61±0.04

Table – 5 Physical propertiesof formulated soup mix

Sample	pH	TSS, (ºbrix)	Bulk density (g/ml)	Tapped density (g/ml)	Carr index (%)	Hausner ratio
Control (C*)	5.43±0.04	5.00±0.05	0.39±0.03	0.58±0.05	32.42±0.04	1.48±0.05
F_1	5.54±0.03	2.00±0.04	0.40±0.03	0.55±0.04	26.96±0.08	1.37±0.04
F_2	5.54±0.03	2.00±0.04	0.42±0.03	0.61±0.05	34.42±0.06	1.44±0.06
F_3	5.56±0.03	1.00±0.05	0.37±0.03	0.56±0.06	33.88±0.05	1.51±0.06

Table – 6 Water holding capacity, oil absorption capacity, rehydration ratio and swelling index of formulated soup mix

Sample	**WHC (g/g)**	**OAC (ml/g)**	**Rehydration ratio**	**Swelling index**
Control (C*)	24.62±0.06	0.56±0.05	3.60±0.04	1.20±0.05
F_1	25.97±0.06	0.60±0.04	3.53±0.04	1.56±0.05
F_2	24.33±0.06	0.80±0.04	3.37±0.04	1.72±0.05
F_3	25.66±0.05	1.00±0.06	3.50±0.04	1.53±0.06

Table – 7Microbial analysis

Samples	**Total plate count (CFU/g)**	**Coliform count (CFU/g)**	**Yeast and mould count (CFU/g)**
Control (C*)	1×10^3	Nil	Nil
F_1	1×10^3	Nil	Nil
F_2	1×10^3	Nil	Nil
F_3	2×10^3	Nil	Nil

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 6, ISSN No. 2455-2143, Pages 218-227
Published Online October 2022 in IJEAST (http://www.ijeast.com)

Sensory analysis

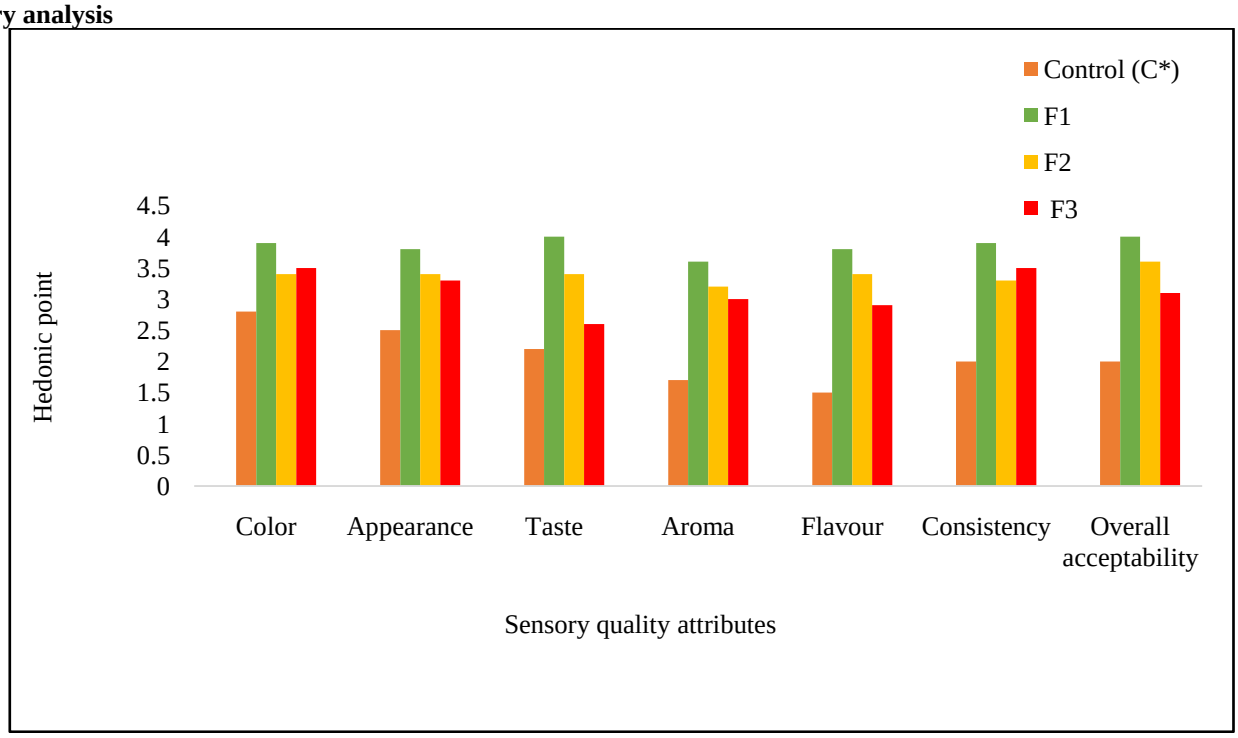

Fig. 11Sensory evaluation score card

IV. CONCLUSION

From the above results it may be stated that a nutritious instant soup mix can be formulated using Moringa oleifera leaves and banana pseudo stem powder. Tray drying of Moringa oleifera leaves at 60 ºC for 8 hours and banana pseudo stem at 70 ºC for 8 hours proved to retain the nutritional value and a domestic kitchen grinder was used to powder the dried samples. The formulated instant soup mix using moringa leaves powder and banana pseudo stem powder proved to be the best and accepted by consumers and it is apparent through the sensory evaluation data obtained.

REFERENCES

[1]. Akpapuimam, M. A., & Markakis, P. (1981). Physicochemical and nutritional aspects of cowpea flour, Journal of food Science, 46(3), 972-973.

[2]. Ali, M. A., Yusof, Y. A., Chin, N. L., & Ibrahim, M. N. (2017). Processing of Moringa leaves as natural source of nutrients by optimization of drying and grinding mechanism, Journal of Food Process Engineering, 40(6), e12583.

[3]. Ansari, F., Singh, A., Baidya, K., Rana, G. K., & Bharti, A (2020). Formulation and development of instant soup mix using Moringa oleifera leaf powder, Journal of Pharmacognosy and phytochemistry,9(6s), 429-432.

[4]. AOAC, 2006. Official Methods of Analysis of the Association of Analytical Chemist.

[5]. Carr, R. L. (1965). Evaluating flow properties of solids, Chem. Eng., 18, 163-168.

[6]. Dawn CP, Ambrose, Lakshman R, Naik Ravindra. (2016). Studies on the drying kinetics and quality assessment of banana pseudostem waste for effective utilization as a value-added product. International Journal of Farm Sciences. 2016;6(2):276-285.

[7]. Gould, J. M., Jasberg, B. K., & Cote, G. L. (1989). Structure-function relationships of alkaline-peroxide treated lignocellulose from wheat straw. Cereal chemistry, 66(3), 213-217.

[8]. Hausner, H. H. (1967). Friction conditions in a mass of metal powder, Polytechnic Inst. of Brooklyn, Univ. of California, Los Angeles.

[9]. Ho, D., &Hoon, L. (2018). The Characterization of Banana (Musa acuminata× balbisiana ABB cv. Awak) Pseudo-Stem Flour.

[10]. Krokida, M. K., &Marinos-Kouris, D. (2003). Rehydration kinetics of dehydrated products, Journal of food engineering, 57(1), 1-7.

[11]. Lakshman, R., Ambrose, D. C., &Chelvame, D. (2015). Studies on the Quality of Banana Centre Core Flour Prepared by Different Drying Methods. Studies, 3(1).

[12]. Merrill, M. D., & Boutwell, R. C. (1973). 4: Instructional Development: Methodology and Research. Review of research in education, 1(1), 95-131.

[13]. Nikita Mishra, S. K. Jain and Yogendra Kumar Jyoti (2020). Comparative Study on Effect of Different Drying Methods on Drying Kinetics of Moringa Leaves. Int.J.Curr.Microbiol.App.Sci. 9(08): 3186-3193.

[14]. Niththiya, N., Vasantharuba, S., Subajini, M., &Srivijeindran, S. (2014). Formulation of instant soup mix powder using uncooked palmyrah (Borassus flabellifer) tuber flour and locally available vegetables.

[15]. Olabode, Z. A. I. N. A. B., Akanbi, C. T., Olunlade, B., & Adeola, A. A. (2015). Effects of drying temperature on the nutrients of Moringa (Moringa oleifera) leaves and sensory attributes of dried leaves infusion. Direct Research Journal of Agriculture and Food Science, 3(5), 177-122.

[16]. Premi, M., Sharma, H. K., Sarkar, B. C., & Singh, C. (2010). Kinetics of drumstick leaves (Moringa oleifera) during convective drying. African Journal of Plant Science, 4(10), 391-400.

[17]. Raju, S. K., Philomena Joy Lindsey, A., &EmilinRenitta, R. (2019). Shelf life assessment of banana pseudostem cutlet.

[18]. Saravanan, K., &Aradhya, S. M. (2011). Potential nutraceutical food beverage with antioxidant properties from banana plant bio-waste (pseudostem and rhizome). Food & Function, 2(10), 603-610.

[19]. Sudarsan, S. M., Santhanam, S. G., &Visalachi, V. (2016). Development and formulation of instant soup mix from sprouted horse gram and radish leaves. International Journal of Home Science, 3(1), 346-349.

[20]. Thorat, R. L., &Bobade, H. P. (2018). Utilization of banana pseudo-stem in food applications. International Journal Of Agricultural Engineering, 11(Special Issue), 86-89.

[21]. Tiroutchelvame, D., Pragalyaashree, M., & Peter, D. (2019). Process development for the value addition of banana central core (pseudo stem). Int J Recent TechnolEng, 8(4), 1055.

[22]. Ukpabi, U. J., &Ndimele, C. (1990). Evaluation of the quality of gari produced in Imo State. Nigerian Food Journal, 8, 105-110.

[23]. Yuliatmoko, W., Murdiati, A., Pranoto, Y., &Marsono, Y. (2019). Chemical and functional properties of Cavendish Jepara 30 (Musa cavendishii) banana pseudostemflour after blanching and soaking in sodium bisulphite solution. Pakistan Journal of Nutrition, 18(10), 936-945.