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RESEARCH ARTICLE
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ANTIOXIDATIVE POTENTIAL AND STORAGE STABILITY OF DEHYDRATED EGGPLANT INCORPORATED INSTANT SOUP

Madiha Rohi[1], Fiza Aslam[2], Zonaira Nasir[3], Irslan Ali[4], Sadaf Javaria[5*], Misbah Ajaz[6], Noor ul Ain[7], Rabia[8], Yasmeen Bano[9], Qamar Sajjad[10]

[1]Department of Food Science and Technology, Government College Women University, Faisalabad, Pakistan
[2]Department of Botany, University of Agriculture, Faisalabad, Pakistan
[3]University of Veterinary & Animal Sciences, Lahore, Pakistan
[4]Horticultural Research Institute, National Agricultural Research Center, Islamabad, Pakistan
[5*]Institute of Food Science and Nutrition Gomal University, Dera Ismail Khan, Pakistan
[6]College of Human Nutrition and Dietetics, Ziauddin University, Karachi, Pakistan
[7]Institute of Food Science and Nutrition Gomal University, Dera Ismail Khan, Pakistan
[8]Department of Food Science and Technology, Government College Women University, Faisalabad, Pakistan
[9]Department of Food Science and Technology, University of Agriculture Faisalabad, Sub-Campus, Burewala, Pakistan
[10]National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan

***Correspondence:** Sadaf Javaria
***Email:** sadafjavaria@yahoo.com

ABSTRACT
Eggplant (*Solanum melongena L.*) is a significant vegetable crop that provides various minerals, vitamins, and dietary fibers along with important phytochemicals and has antioxidant properties. It possesses low calorific value with high moisture content, so it can work as an anti-obesity, anti-inflammatory, and anti-diabetic agent and also has cardioprotective functions. This study is based on the formation of eggplant powder which was utilized for the manufacturing of eggplant-based instant soup mixes to enhance oxidative and storage stability of soup. Treatments were selected on a hit-and-trial basis for product development. Eggplant powder was assessed for proximate composition, functional properties, and total phenolic contents. The product was prepared according to the selected treatment plan and analyzed for proximate analysis, functional properties, mineral analysis, and antioxidative test (polyphenolic contents and DPPH analysis). Storage study was performed at an interval of ten days, the product was reconstituted and evaluated for total phenolic contents and rheological properties on 0, 10th, 20th, and 30th day. Data was analyzed by applying statistics 8.1.

Keywords: Eggplant Powder, Instant Soup, Polyphenols, Antioxidative

INTRODUCTION
Solanum melongena L., often known as eggplant, aubergine, guinea squash, or brinjal, is a valuable vegetable crop grown in tropical and temperate climates (Kashyap *et al.*, 2003). Depending on the

cultivar, eggplant comes in a variety of shapes, sizes, and colors. Typically, eggplant fruit colors include purple, white, and striped. The presence of anthocyanin causes the purple hue of eggplant fruits, with the purple one being more commercially important. Because of its high oxygen radical scavenging capacity, eggplant is one of the top ten vegetables (Jung *et al*., 2011).

Eggplant is also high in dietary fiber. Antioxidant capacity is one of the typical properties of functional substances, according to Jacob *et al*. (2012). As a result, eggplant is recommended as a functional ingredient in the production of functional foods with increased nutritional content. In 2016, global eggplant production reached 60.19 million tones, with China leading the way (29.5 million tons), India (18.5 million tons), Europe (4.32 million tons), Egypt (3.2 million Tonnes), Iran (2.85 million Tonnes), and Turkey (1.82 million Tonnes) (FAO, 2017).

Solanum species have been shown to lower the level of low-density lipoprotein (LDL) and increase the level of high-density lipoprotein (HDL) ratios in hypercholesterolemic rabbits (Odetola *et al*., 2004). They are good veggies for persons who have high blood pressure, high cholesterol, or other ischemic heart conditions. Constipation, colon and rectum cancer, diverticulitis, and atherosclerosis may all be prevented by eating eggplants because of their high crude fiber and low fat content. They could also contribute to weight loss (Edijala *et al*., 2005).

These veggies are also beneficial in the control of diabetes mellitus due to their high fiber content and low carbohydrate content. In terms of nutritional value, eggplant is considered one of the healthiest vegetables due to its high level of insoluble dietary fiber, vitamins, minerals, and bioactive substances (Gurbuz) (Taher *et al*., 2017). In terms of oxygen radical absorption capacity, eggplant is among the top ten vegetables. The high quantity of phenolic compounds, anthocyanins, and flavonoids in eggplant is linked to its bioactive characteristics (Mennella *et al*., 2012).

Many people today, especially those who live in big cities, require a fast-paced and practical lifestyle in practically every aspect of their lives, including food preparation, processing, and presentation. It fosters a society that values instant food products like ready-to-cook and ready-to-eat meals. Functional soup mix is one of the things that could be converted into a quick food (Upadhyay *et al*., 2017).

It is suggested that the soup should be included in the human diet to aid reduce energy intake and promote weight loss by stimulating salivary production and gastrointestinal peristalsis. Soup has been shown to cause delayed and moderate insulin secretion, which can contribute to increased meal saturation (Chiang *et al*., 2007). Soup is likely one of the oldest dishes, having evolved about the time that boiling was discovered as a method of heating food. It was a quick method of cooking. Soups can be made using chicken, meat, seafood, or vegetables, or a mixture of all three, then cooked in hot or boiling water until the flavor is extracted and a broth is formed. Despite their stylistic differences, However, all of the soup preparation techniques involve boiling for flavor extraction and heat-induced composition interaction (Shashidhar *et al*., 2014).

OBJECTIVES

Following are the aims of the present study

- Preparation of instant soup mix by incorporating dried eggplant powder
- Investigation of physio-chemical characteristics of eggplant-based instant soup mix
- Determination of the effect of storage anti-oxidative contents of instant soup mixes

MATERIAL AND METHODS

Procurement of raw materials

Eggplant, all spices, and required vegetables were procured from a local market located in Faisalabad.

Formation of eggplant powder

The round eggplants were thinly sliced and placed in a hot air oven at 80°C for 12 hours. Dried eggplant was ground into powder by using a Grinder (Ali *et al*., 2020).

Analysis of eggplant powder

Functional properties proximate composition, mineral profile, TPC, and calorific value, of eggplant powder were performed according to the specific method as described below.

Drying of the chicken and vegetables for soup mix

Carrot, capsicum, and cabbage, were chopped into small pieces then blanched for 5 minutes and diced into small pieces. The chicken was boiled and cooked properly and cut into small pieces. Diced vegetables and chicken were dried in a hot air oven at 85°C for 12 hrs. (Upadhyayi *et al*., 2017) and preserved for further formation.

Development of an instant soup mix

Treatment plan has been given in Table 1. Instant soup mix was prepared according to the treatment plan by following the recipe of Upadhyayi *et al.* (2017) with minor modifications.

Table 1: Treatment plan for the formation of eggplant-based instant soup mix (Eggplant powder and corn flour)

Treatments	Corn Flour %	Eggplant Powder %
T_0	100	0
T_1	75	25
T_2	50	50
T_3	25	75
T_4	0	100

Eggplant (EP) based instant soup mix analysis

- **Functional properties of Eggplant-based instant soup mix**

To determine water and oil absorption capacities, forming capacities (FC), form stability (FS), and bulk density. The functional properties of flour samples were performed.

1. **Water and oil absorption capacities of Eggplant-based instant soup mix**

According to the Yousaf *et al*. (2016) process, the water and oil absorption ability of whole wheat flour and composite flour samples have been calculated.

2. Bulk density of Eggplant-based instant soup mix

Bulk density of eggplant-based instant soup mix was analyzed according to the Falade and Christopher (2015) process.

3. Foaming capacities (FC) and foam stability (FS) of EP-based instant soup mix

The Yousaf *et al*. (2016) method had been used to assess the foam potential and stability of all samples of whole wheat flour and composite flour.

- **DPPH analysis of eggplant powder**

Anti-oxidative activity of eggplant powder was done by adopting the method of Scorsatto *et al.* (2017).

Proximate analysis of Eggplant-based instant soup mix

Determination of crude moisture, crude ash, crude protein, crude fat, and crude fiber content of dried vegetarian soup mixtures according to AOAC (2019).

- **Minerals analysis of Eggplant-based instant soup mix**

Soup were analyzed for mineral content using Atomic Absorption Spectrophotometer and Flame Photometer following the procedure reported in AOAC (2019).

- **Calorific value of Eggplant-based instant soup mix**

For calculating the total calories of instant mix vegetable soup formula is given below (Ansari *et al*. 2021).

Total calories= fat × 9 + protein × 4 + total carbohydrate× 4

- **Antioxidative capacity of Eggplant-based instant soup mix**

1. Total phenolic content of Eggplant-based instant soup mix

Total phenolic content of instant soup was determined spectrophotometrically by using Foline Ciocalteu's reagent (Rekha *et al*., 2010).

2. DPPH analysis of Eggplant-based instant soup mix

Anti-oxidative activity of eggplant based instant soup mix had been done by adopting the method of Scorsatto *et al*. (2017).

- **Rheological characteristics of Eggplant-based instant soup mix**

1. Reconstitution of EP-based instant soup mix

Reconstitution of formulated soup mix was done (Niththiya *et al.,* 2014*)* and analyzed for viscosity by using a viscometer (Upadhyay *et al.,* 2017)

2. Determination of viscosity of EP-based instant soup mix

For determination of viscosity of EP-based instant soup. The viscometer was cleaned with ethanol and water before drying it. Once the large bulge viscometer was filled to the desired level, the liquid was allowed to flow through the capillary tube with a run time set for when it reached the higher mark on the viscometer and a stop time set for when it reached the bottom mark. The liquid was pipetted until the little bulge was full. The experiment was conducted three to four times and the data was recorded. Then computed the viscosity. SI unit of viscosity is pascal-second or kg/m/s. Calculate the viscosity by the formula

$(\eta_1)/(\eta_2)=(t_1 d_1)/(t_2 d_2)$

η_1 = the viscosity of liquid 1

η_2 = the viscosity of water 0.891 poise

t_1 = flow time of liquid 1

t_2 = flow time of water

d_1 = density of liquid 1

d_2 = density of water 0.997 g/cm^3

- **Storage study of eggplant-based instant soup mix**

Product was reconstituted and evaluated for total phenolic contents and rheological characteristics after intervals of 10 days, 20 days, and 30 days.

- **Statistical analysis of Eggplant-based instant soup mix**

The data was analyzed by using statistics 8.1 in order to investigate the effectiveness of each parameter (Montgomery *et al*., 2013). For data management and collecting, Microsoft Excel was also used. Three replicates of each sensory response test were used. To investigate significance differences and to separate mean values Analysis of variance (ANOVA) was used.

RESULTS AND DISCUSSION

Analysis of eggplant powder

Proximate composition of eggplant powder

The mean values of eggplant powder have been shown in Table 2. Triplicate samples of eggplant were analyzed to gain constant results of the proximate composition of eggplant powder. Results showed that eggplant powder contains 8.61%/100g moisture content, 10.59%/100g protein content, 15.37%/100g fiber content, 3.24%/100g fat content, and 6.81%/100g ash content. The results were also matched with Raigon *et al*., (2010) in which eggplants were dried in a hot air oven and used in the formation of eggplant and corn starch-based biodegradable edible films.

Functional properties of eggplant powder

Water holding capacity (WHC) of the samples ranged from 0.99 to 1.3 g water/g powder. Table 3 displays the average value of the triple eggplant powder samples. Comparable results (1.28 g water/g flour) were seen with hot air-dried eggplant flour (Jenny *et al.,* 2018). One important functional characteristic of proteins is their ability to absorb water. This is especially important in rich foods like soups, sauces, doughs, baked goods, and other products that need a strong protein-water interaction (Granato *et al.,* 2004). The water holding capacity helps in modifying the viscosity and texture of food.

Total phenolic contents of eggplant powder

Polyphenols are a vast group of phytochemicals that contribute to the health benefits of fruits and vegetables. The chemical nature of plant polyphenols allows them to scavenge free radicals. The Total Phenolic Content (TPC) was significantly higher in samples; their mean values have been shown in Table 4. The results showed that eggplant powder contains 6213 mgCAE/ kg. Similar data were reported by Raigon *et al*. (2010), the juice from 31 eggplant cultivars (commercial varieties, landraces, and landrace hybrids) ranged from 5450 to 10,480 mg chlorogenic acid per kg of sample. It was discovered that eggplant has significant intraspecific variation for the composition variables evaluated, and in some situations, there are significant variances between varietal kinds.

Calorific value of eggplant powder

The mean value of the calorific value of eggplant flour, which has been calculated by using the formula, is presented in Table 4. The calorific value of eggplant powder was found 293.28 (kcal). These findings were similar to the results of Niththiya *et al*. (2014), whose calorific value ranged from 333.42 to 351.32 (kcal/100g).

Mineral contents of eggplant powder

Mean values for mineral contents of eggplant flour have been shown in Table 5. Triplicate samples of eggplant powder were analyzed for constant reading. The results showed that the potassium content (231.85mg/100g) was present in higher amounts than other minerals. Magnesium 12.75 mg/100g, zinc 0.16 mg/100g ad iron 0.849 mg/100g were present in eggplant flour, which is dried through a hot air oven. These results were similar to the results of Arivalagan *et al.* (2013). He reported an amount of potassium 177.19mg/100g, iron 0.846 mg/100g, and zinc 0.23 mg/100g in eggplant.

DPPH analysis of eggplant powder

Mean values for the DPPH level of eggplant flour have been shown in Table 6. Triplicate samples of eggplant powder were analyzed for constant reading. The results showed that the DPPH level of eggplant flour was 4.48% which ensures that eggplant flour contains a high amount of polyphenols. These results were in accordance with the findings of Scorsatto *et al*. (2017) whose values ranged from 4.04-4.49%.

Analysis of eggplant-based instant soup mix

Functional properties of eggplant-based instant soup mix

Functional properties play a significant role in the quality of eggplant-based instant soup mix

Bulk density of eggplant-based instant soup mix

Eggplant-based instant soup mix had a highly significant ($p<0.01$) difference. The analysis of variance regarding the bulk density of eggplant-based instant soup mix has been explicited in Table 7. Mean values regarding the bulk density of eggplant-based instant soup mix have been shown in Table 8. The bulk density of the instant soup mix ranged from 1.530-1.810 (g/mL). The highest value was revealed in T_4 (1.810 mL/g) while the lowest value was observed in sample T_0 (1.530 ml/g). The increase in bulk density is due to the large particle size of eggplant flour and its low weight. This result is in accordance with the findings of Ssepuuya *et al*. (2018), whose values ranged from 0.80-0.84 (mL/g).

Water holding capacity of eggplant-based instant soup mix

The mean square for eggplant based instant soup mix water absorption ability has been defined in Table 7. The mean values regarding WHC have been shown in Table 8. An analysis of variation pertaining to the water holding capacity of instant soup made with eggplant revealed highly significant results ($p<0.01$). Mean values for instant soup mix regarding water absorption capacity ranged from 2.0400-4.0867ml/g. The highest value was found in T_4 (4.0867ml/g) while the lowest value was found in T_0 (2.0400ml/g). The increment in the value of water holding capacity was due to the dryness of the instant soup mix and also due to the increasing percentage of eggplant powder in T_1, T_2, T_3, and T_4. The results were also comparable with Sautot *et al*. (2017) whose values for WHC ranged from 1.04-5.30 ml/g

Oil holding capacity of eggplant based instant soup mix

An analysis of variation pertaining to the oil holding capacity of instant soup made with eggplant revealed highly significant results ($p<0.01$). The mean square for eggplant based instant soup mix oil absorption ability has been defined in Table 7. The mean values of OHC have been displayed in Table 8. Mean values for instead soup mix regarding oil absorption capacity ranged from 2.056-2.826 g/mL. The highest value was found in T_4 (2.826 g/mL) while the lowest value was found in T_0 (2.056 g/mL). The increment in the value of oil holding capacity was due to the dryness of the instant soup mix and also due to the increasing percentage of eggplant powder in T_1, T_2, T_3, and T_4. The results were also comparable with Sautot *et al*. (2017) whose values for OHC ranged from 1.1-1.7 g/mL

Foaming capacity of eggplant based instant soup mix

An analysis of variation pertaining to the foaming capacity of instant soup made with eggplant revealed highly significant results ($p<0.01$). The mean value for eggplant based instant soup mix foaming capacity has been defined in Table 7. The mean values regarding foaming capacity have been displayed in Table 8. Mean values for instead soup mix regarding oil absorption capacity range from 50.17-59.00g/mL. The lowest value was found in T_0 (50.17g/mL) while the highest value was found in T_4 (59.00g/mL). The increment in the value of foaming capacity was due to the dryness of the instant soup mix and also due to the increasing percentage of eggplant powder in T_1, T_2, T_3, and T_4. The results were also comparable with Anju *et al*. (2017) whose values for OHC ranged from 1.1-1.7 g/mL.

Foaming stability of eggplant based instant soup mix

An analysis of variation pertaining to the foaming stability of instant soup made with eggplant revealed highly significant results ($p<0.01$). The mean values for eggplant based instant soup mix foaming stability has been defined in Table 7. The mean values regarding foaming stability have been displayed in Table 8. Mean values for instant soup mix regarding foaming stability ranged from 2.056-2.826g/ml the highest value was found in T_4 (2.826g/ml) while the lowest value was found in T_0 (2.056g/ml). The increment in the value of foaming capacity was due to the dryness of the instant soup mix and also due to the increasing percentage of eggplant powder in T_1, T_2, T_3, and T_4. These results were also comparable with Anju *et al*. (2017) whose values for OHC ranged from 1.1-1.7 g/ml.

Proximate composition of eggplant-based instant soup mix

Moisture content in eggplant-based instant soup mix

An analysis of variation pertaining to the moisture content of instant soup made with eggplant revealed highly significant results ($p<0.01$). The statistical analysis of eggplant-based instant soup mix showed that the mean squares regarding moisture content of eggplant-based instant soup have been shown in Table 9. The mean values of moisture content have been presented in Table 10. Mean values for moisture content of eggplant-based instant soup mix varied from 7.707% to 11.11%. The highest value was found in treatment T_4 (11.11%) whereas the lowest value was found in T_0 (7.707%). The present study was also comparable to the work of Sarkar *et al*. (2019) who determined moisture content and it ranged from 7.89% to 8.04%.

Crude fiber content in eggplant based instant soup mix

An analysis of variation pertaining to the crude fiber content of instant soup made with eggplant revealed highly significant results ($p<0.01$). The statistical analysis of eggplant based instant soup mix showed that the mean squares regarding crude fiber of eggplant based instant soup mix have been shown in Table 9. Table 10 presents the mean values for crude fiber. Mean values for crude fiber of eggplant based instant soup mix varied from 7.483% to 9.786%. The highest value was found in treatment T_4 (9.786%) whereas the lowest value was found in T_0 (7.483%). These findings were similar to the results of Fahima *et al*. (2007), whose crude fiber content value ranged from 1.87% to 4.81%. The values of crude fiber of eggplant-based instant soup mix were high due to the incorporation of eggplant powder which was high in fiber content.

Crude protein content in eggplant based instant soup mix

An analysis of variation pertaining to the crude fiber content of instant soup made with eggplant revealed highly significant results ($p<0.01$). The statistical analysis of eggplant based instant soup mix showed that the mean squares regarding crude protein of eggplant based instant soup mix have been shown in Table 9. Table 10 presents the mean values for crude protein. Mean values for the crude protein of eggplant based instant soup mix varied from 17.26% to 19.27%. The highest value was found in treatment T_4 (19.27%) whereas the lowest value was found in T_0 (17.26%). These findings were similar to the results of Ssepuuya *et al*. (2018), whose crude protein content value ranged from 12.30% to 13.26%. The value of crude protein in eggplant-based instant soup mix was high due to the incorporation of chicken powder.

Crude fat content in eggplant based instant soup mix

An analysis of variation pertaining to the crude fat content of instant soup made with eggplant revealed highly significant results ($p<0.01$). The statistical analysis of eggplant based instant soup mix showed that the mean squares regarding crude fat of eggplant based instant soup mix have been shown in Table 9. Table 10 presents the mean values for crude fat content. Mean values for crude fat of eggplant based instant soup mix varied from 2.526% to 3.040%. The highest value was found in treatment T_4 (3.040%) whereas the lowest value was found in T_0 (2.526%). These findings were accepted by the results of Sarkar *et al*. (2019), whose crude fat content values ranged from 0.82% to 3.56%. The value of crude fat of eggplant-based instant soup mix was high due to the incorporation of chicken powder while the other ingredients were low in fat content.

Crude ash content in eggplant based instant soup mix

An analysis of variation pertaining to the crude fat content of instant soup made with eggplant revealed highly significant results ($p<0.01$). The statistical analysis of eggplant based instant soup mix showed that the mean squares regarding crude ash of eggplant based instant soup mix have been shown in Table 9. Table 10 presents the mean values for crude fiber. Mean values for crude ash of eggplant based instant soup mix varied from 3.51% to 5.23%. The highest value was found in treatment T_4 (5.23%) whereas the lowest value was found in T_0 (3.51%). These findings were accepted by the results of Ssepuuya *et al*. (2018), whose crude ash content value ranged from 6.41% to 8.27%.

Nitrogen Free Extract of eggplant based instant soup mix

An analysis of variation pertaining to the nitrogen free extract of instant soup made with eggplant revealed highly significant results ($p<0.01$). The mean square regarding NFE for eggplant based instant soup mix has been defined in Table 9. The mean values regarding NFE have been displayed in Table 10. Mean values for instant soup mix regarding nitrogen free extract ranged from 51.557-68.510% the highest value was found in T_0 (68.510%) while the lowest value was found in T_4 (51.557%). The decrease in the value of NFE content of eggplant based instant soup mix was due to decreasing the amount of carbohydrates and increasing the amount of eggplant powder. Results were also comparable with the study of Niththiya *et al*. (2014) whose values ranged from 72.83-79.32%.

Calorific value of eggplant based instant soup mix

An analysis of variation pertaining to the calorific value of instant soup made with eggplant revealed highly significant results ($p<0.01$). The statistical analysis of eggplant based instant soup mix showed that the mean squares regarding the calorific value of eggplant based instant soup mix have been shown in Table 11. Table 12 presents the mean values for calorific value. Mean values for eggplant based instant soup mix regarding the calorific value varied from 310.68 to 337.82 (kcal/100g). The highest value was found in treatment T_4 (310.68kcal/100g) whereas the lowest value was found in T_0 (337.82kcal/100g). These findings were similar to the findings of Niththiya *et al*. (2014), whose calorific value ranged from 333.42 to 351.32 (kcal/100g).

Rheological characteristics of eggplant based instant soup mix

Viscosity analysis of eggplant based instant soup mix

Analysis of variance of various treatments, days, and their interaction effect on viscosity score of eggplant based instant soup has been shown highly significant results $p<0.01$. The statistical analysis of eggplant based instant soup mix showed that the mean square values regarding the viscosity score of eggplant based instant soup mix have been shown in Table 13. Table 14 presents the mean values for viscosity of eggplant based instant soup mix. At 0-day viscosity score ranged from 1.30-1.53Pa.s. The highest value of viscosity was shown by T_0, T_1, and T_2 the reason for the highest viscosity score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_4 because this treatment contained 100% eggplant flour. The present study regarding viscosity was supported by the work of Kim *et al*. (2014) in which viscosity ranged from 1.34 to 2.15Pa.s. After 10 days of storage study value of viscosity ranged from 1.4027 to 1.5000Pa.s. The highest value of viscosity was shown by T_0, T_1, and T_2. The reason for the highest viscosity score in these three treatments is due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_4 because this treatment contained 100% eggplant flour. After 20 days viscosity of eggplant flour mix score ranged from 1.3260 to 1.4600Pa.s. The highest value of viscosity belongs to T_0, T_1, and T_2. The reason for the highest viscosity score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_4 because this treatment contained 100% eggplant flour. After 30 days viscosity of eggplant flour mix score ranged from 1.29-1.44Pa.s. The highest value of viscosity was shown by T_0, T_1, and T_2. The reason for the highest viscosity score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_4 because this treatment contained 100% eggplant flour. During the storage time (0 to 30 days), T_1 achieved good results on the 0, 10, and 20 day storage intervals, whereas T_0 performed well on the 30th day of the storage period. These treatments suggested the optimal storage conditions for the instant soup mix. During the study period concerning treatment, T_0 showed the highest viscosity followed by T_1 whereas T_4 showed the lowest viscosity scores however concerning storage the viscosity score was highest at 0 day, and as storage times increased to 30 days, its value decreases in all treatments.

Total phenolic contents of eggplant based instant soup mix

The mean square values regarding the total phenolic contents score of eggplant based instant soup mix have been shown in Table 15. An analysis of variation pertaining to the total phenolic content of instant soup made with eggplant revealed highly significant results ($p<0.01$). At 0 day, TPC score ranged from 2.2540-3.3375mg GAE/ 100g. The highest value of TPC score belongs to T_2, T_3, and T_4. The reason for the highest TPC score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_0 because this treatment contained 0% eggplant flour. The present study regarding TPC was supported by the work of Mohamed *et al*. (2020) in which TPC ranged from 1211.60 to 1222.54 mg GAE/ 100g.

After 10 days of storage study, TPC exhibited a score ranging from 2.2557 to 3.3301mg GAE/ 100g. The highest value of TPC score belongs to T_2, T_3, and T_4. The reason for the highest TPC score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_0 because this treatment contained 0% eggplant flour. After 20 days, the TPC of eggplant flour mix ranged from 2.2463 to 3.3232mg GAE/ 100g. The highest value of TPC was shown by T_2, T_3, and T_4. The reason for the highest TPC score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_0 because this treatment contained 0% eggplant flour. After 30 days TPC of eggplant flour mix score ranged from 2.2903 to 3.3259mg GAE/ 100g. The highest value of TPC was shown by T_2, T_3, and T_4. The reason for the highest TPC score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_0 because this treatment contained 0% eggplant flour. During the storage time (0 to 30 days), T_1 achieved good results on the 0, 10, and 20 days of storage intervals, whereas T_0 performed well on the 30th day of the storage period. These treatments suggested the optimal storage conditions for the instant soup mix. During the study period concerning treatment, T_4 showed the highest TPC followed by T_3 however concerning storage the highest TPC score was found at 0 day, and as storage interval proceeds to 30 days TPC value increases in all the treatments. The highest taste score in these three treatments was due to the addition of eggplant flour with different proportions of corn flour. The lowest value was found in T_4 because this treatment contained 100% eggplant flour.

DPPH analysis of eggplant based instant soup mix

Mean values for the DPPH level of eggplant based instant soup mix have been shown in Table 18. Triplicate samples of eggplant powder were analyzed for constant reading. The results showed that the DPPH level of eggplant based instant soup mix was high in T_4 (4.48%) which ensures that eggplant flour contains a high amount of polyphenols. T_0 had the lowest value which was 3.8%. This result was similar to the findings of Scorsatto *et al*. (2017) whose values ranged from 1.68-6.77 %.

Table 2: Mean values for the proximate composition of eggplant powder

Proximate Composition (%)					
Moisture	**Protein**	**Fiber**	**Fat**	**Ash**	**NFE**
8.61±0.03	10.59±0.02	15.37±0.03	3.24±0.03	6.81±0.04	53.37±0.16

Table 3: Mean values for functional properties of eggplant powder

Functional properties				
Bulk density %	**OHC %**	**WHC %**	**Foaming ability mL**	**Foaming stability mL**
0.88±0.04	2.46±0.02	1.1±0.17	57.33±0.28	55.16±0.28

OHC: oil holding capacity
WHC: water holding capacity

Table 4: Mean values for Calorific value and Total phenolic contents of eggplant powder

Calorific value	**TPC mg CAE/Kg**
293.28±0.56	6213±0.40

Table 5: Mean values for mineral contents of eggplant powder

Minerals content (mg/100g)				
Sodium	**Potassium**	**Magnesium**	**Iron**	**Zinc**
6.29±0.02	231.85±0.02	12.75±0.02	0.849±0.03	0.16±0.002

Table 6: Mean values for DPPH analysis of eggplant powder

DPPH (%)	
Eggplant powder	4.48

Table 7: Mean squares for Functional properties of eggplant based instant soup mix

SOV	**df**	**MS**				
		Bulk density	**WHC**	**OHC**	**Foaming ability**	**Foaming stability**
Treatments	4	0.03378**	2.25914**	0.38342**	32.0768**	13.8083**
Error	10	0.00059	0.00156	0.00085	0.1497	0.1000
Total	14					

**Highly significant p< 0.01, * Significant p≤ 0.05, NS non-significant

WHC:water holding capacity
OHC:oil holding capacity

Table 8: Mean values for functional properties of eggplant based instant soup mix

Treatments	**Functional properties (%age)**				
	Bulk density	**WHC**	**OHC**	**Foaming ability**	**Foaming stability**
T_0	$1.53±0.02^e$	$2.04±0.03^e$	$2.05±0.01^e$	$50.17±0.28^e$	$49.66±0.28^e$
T_1	$1.59±0.02^d$	$2.15±0.04^d$	$2.14±0.02^d$	$53.50±0.5^d$	$50.83±0.28^d$
T_2	$1.65±0.01^c$	$2.29±0.04^c$	$2.25±0.05^c$	$55.16±0.28^c$	$52.50±0.5^c$
T_3	$1.70±0.03^b$	$3.15±0.04^b$	$2.75±0.01^b$	$56.16±0.28^b$	$54.00±0.28^b$
T_4	$1.81±0.02^a$	$4.08±0.03^a$	$2.82±0.02^a$	$59.00±0.5^a$	$54.83±0.5^a$

Means carrying different letters are significantly different from each other
Values are means ± for five treatments were analyzed individually

Where,
T_0 - Soup mix with 0% Eggplant powder + 100% Corn flour
T_1 - Soup mix with 25% Eggplant powder + 75% Corn flour
T_2 -Soup mix with 50% Eggplant powder + 50% Corn flour
T_3 - Soup mix with 75% Eggplant powder + 25% Corn flour
T_4 - Soup mix with 100% Eggplant powder + 0% Corn flour

Table 9: Mean squares for proximate composition of eggplant based instant soup mix

SOV	**Df**	**MS**					
		Moisture	**Protein**	**Fiber**	**Fat**	**Ash**	**NFE**
Treatments	4	5.10464**	43.8476**	2.57208**	0.12174**	1.25061**	129.692**
Error	10	0.00086	0.0008	0.00075	0.00086	0.00081	0.015
Total	14						

**Highly significant p< 0.01, * Significant p≤ 0.05, NS non-significant

Table 10: Mean values for proximate composition of eggplant based instant soup mix

Treatments	Proximate Composition (%age)					
	Moisture	Protein	Fiber	Fat	Ash	NFE
T_0	7.70±0.02^e	17.26±0.02^e	7.48±0.03^e	2.52±0.01^e	3.51±0.03^e	68.51±0.10^e
T_1	8.53±0.03^d	18.28±0.02^d	8.84±0.03^d	2.59±0.03^d	4.09±0.03^d	57.65±0.14^d
T_2	9.36±0.02^c	18.38±0.03^c	9.09±0.02^c	2.86±0.02^c	4.57±0.02^c	55.91±0.13^c
T_3	9.94±0.03^b	19.08±0.03^b	9.69±0.04^b	2.78±0.04^b	4.65±0.03^b	53.78±0.09^b
T_4	11.11±0.03^a	19.27±0.03^a	9.78±0.03^a	3.04±0.03^a	5.23±0.02^a	51.55±0.14^a

Means carrying different letters are significantly different from each other
Values are means ± for five treatments were analyzed individually

Where,
T_0 - Soup mix with 0% Eggplant powder + 100% Corn flour
T_1 - Soup mix with 25% Eggplant powder + 75% Corn flour
T_2 -Soup mix with 50% Eggplant powder + 50% Corn flour
T_3 - Soup mix with 75% Eggplant powder + 25% Corn flour
T_4 - Soup mix with 100% Eggplant powder + 0% Corn flour

Table 11: Mean squares for calorific value of eggplant based instant soup mix

SOV	Df	MS
Treatments	4	323.998**
Error	10	0.075
Total	14	

**Highly significant p< 0.01, * Significant p≤ 0.05, NS non-significant

Table 12: Mean values for calorific value of eggplant based instant soup mix

Treatments	Calorific value (kcal/100g)
T_0	337.82±0.39^a
T_1	327.06±0.21^b
T_2	321.32±0.17^c
T_3	316.53±0.33^d
T_4	310.68±0.17^e

Means carrying different letters are significantly different from each other
Values are means ± for five treatments were analyzed individually

Where,
T_0 - Soup mix with 0% Eggplant powder + 100% Corn flour
T_1 - Soup mix with 25% Eggplant powder + 75% Corn flour
T_2 -Soup mix with 50% Eggplant powder + 50% Corn flour
T_3 - Soup mix with 75% Eggplant powder + 25% Corn flour
T_4 - Soup mix with 100% Eggplant powder + 0% Corn flour

Table 13: Mean squares for viscosity of eggplant based instant soup mix

SOV	Df	MS
Days	3	0.10772**
Treatments	4	0.05745**
Days × Treatments	12	0.00073*
Error	40	0.00037
Total	59	

**Highly significant p< 0.01, * Significant p≤ 0.05, NS non-significant

Table 14: Mean values viscosity of eggplant based instant soup mix

Treatments	**Days**				**Means**
	0	**10**	**20**	**30**	
T_0	1.50±002^{a}	1.50±0.02^{ab}	1.46±0.02^{cd}	1.44±0.01^{d}	1.48^{a}
T_1	1.48±0.0^{bc}	1.45±0.01^{cd}	1.38±0.02^{fg}	1.36±0.02^{gh}	1.42^{b}
T_2	1.44±0.02^{de}	1.41±0.01^{ef}	1.31±0.01^{ij}	1.28±0.01^{jk}	1.36^{c}
T_3	1.34±0.02^{i}	7.33±0.02^{cde}	1.27±0.02^{k}	1.22±0.02^{l}	1.30^{c}
T_4	1.30±0.02^{j}	1.30±0.01^{jk}	1.20±0.02^{l}	1.16±0.01^{m}	1.24^{d}
Means	1.42^{a}	1.40^{b}	1.32^{c}	1.29±^{d}	

Means carrying different letters are significantly different from each other
Values are means ± for five treatments were analyzed individually

Where,
T_0 - Soup mix with 0% Eggplant powder + 100% Corn flour
T_1 - Soup mix with 25% Eggplant powder + 75% Corn flour
T_2 -Soup mix with 50% Eggplant powder + 50% Corn flour
T_3 - Soup mix with 75% Eggplant powder + 25% Corn flour
T_4 - Soup mix with 100% Eggplant powder + 0% Corn flour

Table 15: Mean squares for total phenolic contents of eggplant based instant soup mix

SOV	Df	MS
Days	3	0.00058**
Treatments	4	4.49361**
Days × Treatments	12	0.00047^{NS}
Error	40	0.00038
Total	59	

**Highly significant p< 0.01, * Significant p≤ 0.05, NS non-significant

Table 16: Mean value for total phenolic contents of eggplant based instant soup mix

Treatments	Days				Means
	0	10	20	30	
T_0	2.2540[f]	2.2557[f]	2.2463[f]	2.2903[e]	2.2616[d]
T_1	3.3940[c]	3.3787[cd]	3.3670[cd]	3.3613[d]	3.3752[c]
T_2	3.6037[b]	3.5977[b]	3.5973[b]	3.5860[b]	3.5962[b]
T_3	3.7147[a]	3.7067[a]	3.6990[a]	3.6917[a]	3.7030[a]
T_4	3.7213[a]	3.7117[a]	3.7063[a]	3.7003[a]	3.7099[a]
Means	3.3375[a]	3.3301[ab]	3.3232[b]	3.3259[ab]	

Where,
T_0 - Soup mix with 0% Eggplant powder + 100% Corn flour
T_1 - Soup mix with 25% Eggplant powder + 75% Corn flour
T_2 -Soup mix with 50% Eggplant powder + 50% Corn flour
T_3 - Soup mix with 75% Eggplant powder + 25% Corn flour
T_4 - Soup mix with 100% Eggplant powder + 0% Corn flour

Table 17: Mean squares for DPPH analysis of eggplant based instant soup mix

SOV	Df	MS
Treatments	4	0.22242**
Error	10	0.00193
Total	14	

**Highly significant $p< 0.01$, * Significant $p\leq 0.05$, NS non-significant

Table 18: Mean values for DPPH analysis of eggplant based instant soup mix

Treatments	DPPH value (%)
T_0	3.8000±0.01[e]
T_1	3.9700 ±0.02[d]
T_2	4.1133 ±0.09[c]
T_3	4.3100±0.02[b]
T_4	4.4900 ±0.01[a]

Means carrying different letters are significantly different from each other
Values are means ± for five treatments were analyzed individually

Where,
T_0 - Soup mix with 0% Eggplant powder + 100% Corn flour
T_1 - Soup mix with 25% Eggplant powder + 75% Corn flour
T_2 -Soup mix with 50% Eggplant powder + 50% Corn flour
T_3 - Soup mix with 75% Eggplant powder + 25% Corn flour
T_4 - Soup mix with 100% Eggplant powder + 0% Corn flour

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