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PRODUCTION AND EVALUATION OF THE FUNCTIONAL AND SENSORY PROPERTIES OF DEHYDRATED EWEDU SOUP MIX

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ABSTRACT

Ewedu soup is a mucilaginous and very slimy soup made from jute mallow leaves (Corchorus olitorius), mainly consumed by the Yoruba tribe (western region) of Nigeria. This study aimed to produce and evaluate the functional and sensory properties of instant dehydrated ewedu soup mix. The jute leaves were sorted, destemmed, washed, drained and freeze-dried in a vacuum chamber of freeze dryer at a pressure (20 Pa) for 3 hours. The dry leaves were blended with varying levels of ingredients in the ratio of 86:2:0: 10:2, 76:2:10:10:2, 96:2:0:0:2, 88:0:0:10:2 and 98:0:0:0:2 for ewedu leaf, dry paper, dry fish, iru, and potash at 100g. The samples were labelled A, B, C, D and E. The five samples were analyzed for functional and sensory analysis. The values of 7.20-9.93%, 6.61-9.71%, 0.72-0.93 g/mL, and 1.51-4.04g/mL were recorded for water absorption capacity, oil absorption capacity, bulk density, and swelling index values, respectively. The recipe formulation affected the sensory attributes of the ewedu soup. Sample B (dry pepper, dry fish and iru) was preferred due to its balanced flavor profile and pleasant aroma. Dehydrated instant ewedu soup mix should be prepared using a ratio of 76:2:10: 10:2 for ewedu, dried pepper, dried fish, iru and potash.

Keywords*:* *Ewedu,* Freeze Dryer, Ingredients, Instant Soup

INTRODUCTION

*Ewedu*soup is a mucilaginous and very slimy soup made from jute mallow *Corchorus Olitorius* leaves, mainly consumed by the Yoruba tribe (western region) of Nigeria. It is popularly served as a stew along with staple foods such as *amala* (made from yam, plantain or cassava flour) or *eba* (grated cassava flour), also known as *garr*i (Balogun *et al.*, 2020). These green leafy vegetable leaves are rich sources of potassium, iron, copper, manganese and zinc and high energy values essential in human and animal nutrition (Idirs *et al*., 2009).

Since preparing homemade soup is time-consuming, commercially prepared instant soup has replaced homemade soup in the modern world (Niththiya *et al.*, 2014). The challenges in marketing and preserving fresh jute leaves include quality depreciation and short shelf-life due to its elevated respiratory rate (RR) and subsequent perishability. Dehydrated soup mix has many benefits, including minimal susceptibility to pathogenic attacks, quick preparation times, quality preservation for up to one month under normal conditions, protection from enzymatic and oxidative spoilage, and favour stability at room temperature for an extended period (6–12 months) without the need for preservatives or refrigeration (Sudarsan *et al*., 2017; Mathangi *et al*., 2017; Ansari *et al.,* 2022).

However, most vegetable soups, including *ewedu* soup, rapidly deteriorated due to natural activities such as lipid oxidizing effects, protein denature and enzymatic processes (Gary and Bedford, 2010). Furthermore, frequent reheating of soups to preserve them may degrade their texture and consistency due to the limited or absence of electricity supply (Balogun *et al.*, 2020). The utilization of preservation techniques such as low-temperature techniques (freezing and refrigeration) and dry heat techniques such as oven drying at 50oC have been reported to have little or no effect on the fungal spores of *Botrytis* sp*, Alternaria* sp*, Fusarium* sp*, Diplodia* sp*, Rhizopus* sp*, Monilina* sp*, Penicillium* sp*,* or *Aspergillus* sp which have been implicated as the significant vegetable rot pathogens (Seema, 2015). The shortcomings of the previously stated approaches have been addressed by freeze-drying processes, which also offer a lower risk of contamination (Sagar and Suresh, 2010). According to Pandey *et al*. (2013), freeze-dried soups can be easily reconstituted by adding liquid, giving the soup a fresh taste again with little or no loss of sensory attributes. Thus, there is a need for a dehydrated *ewedu* soup mix, which can be made into soup instantly with improved sensory attributes and shelf-life.

MATERIALS AND METHODS

Source of Materials

Fresh jute leaf (*ewedu* leaf), dried pepper, locust bean (*iru*), dried fish and potash were purchased from Lapai Central Market, Niger state. The reagents used were of analytical standard.

Sample Preparation

Preparation of Dehydrated Jute Leaves (*Ewedu*)

The jute leaves (*ewedu*) leaves were sorted, and the stem was removed and washed under running tap water until it was free from all adhering soil and impurities. The clean leaves were freeze-dried in the vacuum chamber of a freeze dryer (LGJ-18, SHKY, China) at a pressure (20 Pa) for 3 h and blended into a coarse powder using a blender (PANASONIC, MX-AC300, JAPAN). The coarse powder was mixed with different ingredients (*iru*, potash, dried pepper, and dried fish) at different blend ratios, as shown in Table I. They were uniformly blended into a smooth texture and sieved (1.0 mm aperture). The powdered *ewedu* was stored in airtight containers for further analysis.

Preparation of *Ewedu* Soup

Boiling water (100 mL) was measured into five different containers, to which 5 g of *ewedu* soup mix powder was added. The mixture was mixed with a whisk for 1 minute and covered for 3 minutes to produce the *ewedu* soup samples.

Table 1: Blend Formulation for Dehydrated *Ewedu* Soup Mix

Items	Sample A(g)	Sample B(g)	Sample C(g)	Sample D(g)	Sample E (g)
Ewedu	86	76	96	88	98
Dry pepper	2	2	2	----	----
Dry fish	----	10	---	----	----
Iru	10	10	---	10	----
Potash	2	2	2	2	2

A=86% *Ewedu* + 2% Dry pepper + 0% Dry fish + 10% Iru + 2% Potash, B=76% *Ewedu* + 2% Dry pepper + 10% Dry fish + 10% Iru + 2% Potash, C=96% *Ewedu* + 2% Dry pepper + 0% Dry fish + 0% Iru + 2% Potash, D=88% *Ewedu* + 0% Dry pepper + 0% Dry fish + 10% Iru + 2% Potash, E= 98% *Ewedu* + 0% Dry pepper + 0% Dry fish + 0% Iru + 2% Potash

Determination of Functional Properties of Dehydrated*Ewedu* Soup Mix

Water Absorption Capacity

The method described by Onwuka (2005) was used. One gram of the dehydrated *ewedu* soup mix sample was weighed into a 15 mL centrifuge tube and suspended in 10 mL water. It was shaken on a platform tube rocker for 1 minute at room temperature. The sample was allowed to stand for 30 min and centrifuged (MODEL SM 800B UNISCOPE SURGIFRIENDS MEDICALS, ENGLAND) at 500 rpm for 30 min. The volume of free water was read directly from the centrifuge tube. The density of water was taken to be 1 g/mL.

$$Water\ Absorption\ Capacity = \frac{Amount\ of\ water\ added - Free\ water}{Weight\ of\ sample} \times density\ of\ water\ \times 100$$

Oil Absorption Capacity

The method, as described by Onwuka (2005), was used. One (1) gram of the dehydrated *ewedu* soup mix was mixed with 10 mL refined oil in a centrifuge tube and allowed to stand at room temperature (30 ± 2 °C) for 1 h. It was centrifuged (MODEL SM 800B UNISCOPE SURGIFRIENDS MEDICALS, ENGLAND) at 500 rpm for 30 min. The volume of free oil was recorded and decanted. Oil absorption capacity was expressed as mL of oil bound by 100 g dehydrated *ewedu* mix sample**.** The density of oil was taken to be 0.98 g/mL.

$$Oil\ Absorption\ Capacity = \frac{Amount\ of\ oil\ added - Free\ oil}{Weight\ of\ sample} \times density\ of\ oil \times 100$$

Bulk Density

The method described by Onwuka (2005) was adopted to determine bulk density. A graduated cylinder of 10 mL was weighed and gently filled with the dehydrated *ewedu* soup mix sample up to the 10 mL mark. The bottom of the cylinder was then tapped gently on a laboratory bench several times. This continued until no further diminution of the test flour sample in the cylinder after filling to mark was observed. The weight of the cylinder plus the dehydrated *ewedu* soup mix was measured and recorded. Bulk density was expressed as:

$$Bulk\ Density\ (g/\text{mL}) = \frac{weight\ of\ sample\ (g)}{volume\ of\ sample\ (cm^3)}$$

Swelling Index

This was determined using the method described by Onwuka (2005). Ten grams (10 g) of the *ewedu* soup mix sample was introduced into a graduated cylinder with the dry bulk volume noted. After that, 100 mL of boiling water was added to the sample in the cylinder and mixed thoroughly. The volume was measured after 10 minutes, and the swelling index was calculated as follows:

$$\text{Swelling index (mL/g)} = \frac{\text{Change in Volume of Sample (mL)}}{\text{Original Weight of Sample}}$$

Sensory Attributes of Ewedu Soup

Sensory evaluation of the *ewedu* soup was carried out using a 9-point hedonic scale. A panel of Twenty students from the Department of Food Science and Technology, Ibrahim Badamasi Babangida, University, Lapai, Niger State, Nigeria, was chosen based on their familiarity and experience with *ewedu* soup for sensory evaluation. Each sensory attribute (appearance, taste, sliminess, aroma, and overall acceptability) was rated on a 9-point hedonic scale (1 = dislike extremely and 9 = like extremely).

Data Analysis

The GENSTAT Statistical Software (version 17.0) was used for data analyses. Data were subjected to analysis of variance (ANOVA), and the separation of means was done using Duncan's Multiple Range Test (DMRT) at ($P \leq 0.05$).

RESULTS AND DISCUSSION

Functional Properties of Dehydrated Instant *Ewedu* Soup Mix

The results of the functional properties of the different dehydrated Instant *ewedu* soup mix samples are shown in Table 1. There were significant ($p \leq 0.05$) differences in the functional properties of the instant *ewedu* soup mix samples. The water absorption capacity ranged from 7.20-9.93%. According to Anthony *et al*. (2014), carbohydrates have been reported to greatly influence the water absorption capacity of foods. Therefore, the highest content of water absorption capacity recorded in Sample E could be attributed to the ingredients added (98:2) for ewedu and potash. This suggests That a higher proportion of these ingredients could lead to a product with better water absorption properties.

The oil absorption capacity ranged from 6.61-9.71%. According to Ohizua *et al*. (2016) oil absorption capacity measures the ability of food material to absorb oil. The mechanism of fat absorption is attributed mainly to the physical entrapment of oil and the binding of fat to a polar chain of protein (Adeleke and Odedeji, 2010; Chandra *et al*., 2015). The highest oil absorption capacity was recorded in the sample corresponding to the sample with the highest protein source (10% dry fish and 10% *iru*). This is due to the high protein content of dried fish and the added iru. Oil absorption capacities of foods increase with increased protein content since the protein in foods influences fat absorption (Omoniyi *et al*., 2016). Sample B had higher oil absorption capacity as a result of the hydrophobic character of protein in the dehydrated instant *ewedu* soup mix. The presence of protein exposes more non-polar amino acids to the fat and enhances hydrophobicity, as a result of which absorbs more oil (Oluwalana *et al*., 2012)

The bulk density ranged from 0.72-1.03 g/mL. The differences in bulk density may be due to the proportion of some ingredients added. It has been reported by Oppong *et al.* (2015) that bulk density is used to evaluate flour heaviness, handling requirements, and the type of packaging materials suitable for the storage and transportation of food materials. Dried fish and *iru*, being proteinous, do not significantly contribute to bulk density. The low bulk densities seen in sample B suggest a reduced need for packaging in greater quantity than for other samples.

The swelling index ranged from 1.51-4.04 g/mL. The swelling capacity of the samples also followed the same trend as water absorption capacity, with sample B having the lowest (E> C > D >A >B). Swelling capacity was reported as an indication of starch's water-holding capacity. The difference in swelling capacity in this study could be attributed in part to the fact that no protein source (dry fish and *iru*) was added in the formulation (98:2) for *ewedu* and potash in sample E.

Sensory Attributes of *Ewedu* soup

The results of the sensory attributes of the *ewedu* soup samples are presented in Table 2. The appearance of samples A and B was not affected significantly ($p \leq 0.05$) and was most preferred by the panellists. Sample B scored the highest (7.73) in appearance, followed by Sample A (7.60), which could be a result of the ingredients included (*ewedu*, potash, iru and dried fish), which gave it a better appearance and sample E (*ewedu* and potash) had the lowest rating because it had a dark and plain appearance.

Table 1: Functional Properties of Instant *Ewedu* Soup Mix

Samples	WAC(%)	OAC(%)	BD (g/mL)	SI (g/mL)
A	8.40^{c}±0.01	8.81^{d}±0.01	0.81^{b}±0.01	2.06^{b}±0.03
B	7.20^{d}±0.00	9.71^{c}±0.02	0.72^{d}±0.02	1.51^{d}±0.54
C	9.54^{b}±0.01	6.89^{b}±0.01	0.93^{c}±0.01	2.30^{c}±0.28
D	8.65^{c}±0.01	7.59^{a}±0.01	0.86^{b}±0.02	2.08^{b}±0.04
E	9.93^{a}±0.01	6.61^{b}±0.01	1.03^{a}±0.07	4.04^{a}±0.05

Values are means of duplicate determinations. values with same superscript along the same column are not significantly different at p<0.05
Key: WAC (water absorption capacity), OAC (Oil absorption capacity), BD (bulk density) SI (swelling index)
A=86% *Ewedu* + 2% Dry pepper + 0% Dry fish + 10% Iru + 2% Potash
B=76% *Ewedu* + 2% Dry pepper + 10% Dry fish + 10% Iru + 2% Potash
C=96% *Ewedu* + 2% Dry pepper + 0% Dry fish + 0% Iru + 2% Potash
D=88% *Ewedu* + 0% Dry pepper + 0% Dry fish + 10% Iru + 2% Potash
E= 98% *Ewedu* + 0% Dry pepper + 0% Dry fish + 0% Iru + 2% Potash

There was a significant (p≤0.05) difference in the aroma of *ewedu* soup samples. Samples A and B were not affected significantly (p≤0.05), likewise, C and E. The panellists preferred sample B, which recorded the highest score (7.67) for aroma. A similar trend was observed in the taste of *ewedu* soup samples. Sample B also had the highest sensory score for taste. This is a result of the addition of dried fish and *iru*. According to Ajani *et al*. (2012), *iru* has been known as one of the flavour (taste and aroma) enhancers that increase the attributes and palatability of a diet.

The sliminess of samples A and B was not affected significantly (p≤0.05). Likewise, C and E. Sample B showed the lowest score (7.20) for sliminess. This may be attributed to the different ingredients added, which thickened the soup and made it less slimy compared to sample E, which was plain *ewedu* leaves and potash, giving a slimmer feel. All the *ewedu* soup samples were acceptable to the panellists, as indicated by their mean scores for the overall acceptability.

However, sample B was most preferred. This may be attributed to the formulation of the ingredients (dry pepper, dry fish, and iru).

Table 2: Sensory Attributes of Ewedu soup

Sample	Appearance	Aroma	Taste	Sliminess	Overall Acceptability
A	$7.60^{a}\pm0.91$	$7.61^{a}\pm0.74$	$7.67^{a}\pm1.34$	$7.33^{b}\pm1.44$	$8.17^{b}\pm0.91$
B	$7.73^{a}\pm0.96$	$7.67^{a}\pm0.97$	$7.73^{a}\pm1.09$	$7.20^{b}\pm1.47$	$8.27^{a}\pm0.70$
C	$7.33^{b}\pm1.44$	$7.00^{c}\pm1.13$	$6.93^{b}\pm1.43$	$7.67^{a}\pm0.70$	$7.34^{c}\pm1.29$
D	$7.55^{c}\pm1.18$	$7.45^{d}\pm0.39$	$7.55^{c}\pm0.85$	$7.59^{c}\pm0.55$	$7.45^{c}\pm1.53$
E	$6.80^{d}\pm1.56$	$6.93^{c}\pm1.27$	$6.67^{d}\pm1.49$	$7.77^{a}\pm1.29$	$7.33^{c}\pm1.29$

values are means ± standard deviation of triplicate determinations. Means in same column with different superscripts are significantly ($p<0.05$) different.

Key

A=86% *Ewedu* + 2% Dry pepper + 0% Dry fish + 10% Iru + 2% Potash, B=76% *Ewedu* + 2% Dry pepper + 10% Dry fish + 10% Iru + 2% Potash, C=96% *Ewedu* + 2% Dry pepper + 0% Dry fish + 0% Iru + 2% Potash, D=88% *Ewedu* + 0% Dry pepper + 0% Dry fish + 10% Iru + 2% Potash, E= 98% *Ewedu* + 0% Dry pepper + 0% Dry fish + 0% Iru + 2% Potash

CONCLUSION AND RECOMMENDATION

The freeze-drying method is a viable option for dehydrating *ewedu* leaves, with minimal impact on the sensory properties of the *ewedu* soup. This study shows that the recipe significantly ($p\leq0.05$) influenced the functional and sensory properties of the instant soup samples. The instant *ewedu* soup mix (samples C and E) demonstrated good functional properties, with sample B being the clear favourite among the panellists. This strong preference for sample B instils confidence in the recipe's potential success. However, there is a need for further study on the storage stability of dehydrated instant *ewedu* soup mix samples.

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