

Effect of Frozen Storage on the Chemical Stability, Functional and Sensory Properties of ‘Ogbono’ (*Irvingiagarbonensis var. excelsa*) and ‘Egusi’ (*Citrullus vulgaris schrad*) Seed Flours

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Abstract ‘Ogbono’ (*Irvingiagarbonensis var. excelsa*) and ‘egusi’ (*Citrullusvulgariesschrad*) seed flours were packaged separately in vacuum sealed high density polyethylene bags of 0.7mm thickness and were subjected to frozen storage by storing the packs in a domestic deep freezer for up to four months. Samples were removed at intervals of 0, 1, 2, 3 and 4 months for analysis. The effects of frozen storage on the shelf-stability factors (moisture, free-fatty acids and peroxide values), selected functional properties of water/oil absorption capacity, foam capacity and viscosity and sensory attributes of the frozen ‘ogbono’ and ‘egusi’ samples were investigated. The result of this investigation shows that there was no significant difference ($p>0.05$) in storage life (shelf stability factors), selected functional and sensory properties of both “ogbono” and ‘egusi’ seed flours frozen up to three months. However, all the shelf-stability properties, selected functional and sensory properties of both flour samples decreased significantly ($p<0.05$) after four months of frozen storage. Therefore, frozen storage at -18°C could be used to preserve the storage life, functional and sensory properties of vacuum packaged ‘ogbono’ and ‘egusi’ seed flours up to three months in moisture/gas-impermeable polyethylene packs of 0.7mm thickness without losing its sensory properties.

Keywords: ‘Ogbono’, egusi, frozen storage, functional properties, sensory properties

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1. Introduction

‘Ogbono’ (*Irvingiagabonensis*) popularly known as bush mango or African mango or wild mango is an indigenous forest tree belonging to the group of plant classified as non-timber forest products [1]. Ogbono (bush mango) belong to the Irvingiaceae family of plant in the species ‘gabanensis’ of Irvingia. There are two species that grows freely in the southern rain forest of Nigeria, *Irvingiagabonensis var. gabonensis* and *Irvingiagabonensis var. excelsa*. The pulp of the *Irvingiagabonensis var. excelsa* is said to be eaten, although bitter and acrid with the flavour of turpentine and slightly slimy. Its kernel (seed) contains 54 – 67% of fatty matter [1]; hence it can be classified as an oil seed. The kernel serves as condiment used in thickening and flavouring soups. The more the ground kernel ‘draws’ in soup, the more acceptable it is thus *Irvingiagabonensis var. excelsa* which draws more than the *Irvingiagabonensis var. gabonensis* and is more acceptable in soup making in Nigeria [1,2]. On the other hand the pulp of the *Irvingiagabonensis var. gabonensis* is sweet, smooth in the mouth and has brittle pulp but its kernel draws less than that of *Irvingiagabonensis var. excelsa* [3].

Melon seed (*Citrullusvulgariesschrad*) commonly known in West Africa as ‘egusi’ belong to the Cucurbitaceae. Egusi (melon) seeds contain about 53% oil, 28% protein and some other important mineral nutrients [4,5]. Bankoleet al., [6] reported that one major problem that besets melon seeds is that it deteriorates quickly in storage due to fungal infection which decreases the nutritive value, increase in the peroxide value and the production of mycotoxin. Melon most popularly called ‘egusi’ in Nigeria goes by various botanical names according to its variety; these include *Citrillus vulgaris* and *Citrullusedulis* [7].

Fellows [8] stated that the aim of freezing is to preserve functional, nutritional qualities and organoleptic attributes of foods as close as possible to the fresh product. Consumers are now demanding foods that are convenient to prepare and suitable for frozen storage. In Nigeria, there is an increasing demand by consumers of foods that closely resemble the original raw materials and have a healthy or natural image. Frozen storage is the most likely option to guaranty freshness of foods but the question is, for how long? Evans and James [9] defined the storage life as the time the product can be stored frozen and still acceptable to consumers. This means that the storage life is the period that food remains essentially the same as when it was frozen. In Nigeria, there are an increasing

number of working class women who do not have the time to go to the market every week to buy ‘ogbono’ and ‘egusi’. This has led to a new trend where a lot of housewives ground and package ‘ogbono’ and ‘egusi’ in large quantities and store in their domestic freezers for usage over some months. There are some confusion among Nigerian housewives and lack of precise information about the storage life of ground frozen ‘ogbono’ and ‘egusi’ seed flours used in soup preparation. It has been alleged in some quarters that the functional and sensory properties of some frozen ‘ogbono’ and ‘egusi’ seed flours used in soup preparation gave off-flavour and off-odour, loose their thickening properties and draw ability. This study therefore is aimed at determining the effect of frozen storage on the chemical stability, functional and sensory qualities of ‘ogbono’ and ‘egusi’ seed flours stored for up to four months.

2. Materials and Methods

2.1. Materials

‘Ogbono’ (Bush mango) and egusi (melon) seeds and other ingredients were purchased from a local market in Port Harcourt. High density polyethylene bags of 0.7mm were purchased from Mile One market also in Port Harcourt, Nigeria.

2.2. Methods

2.2.1. Preparation of Ogbono and Egusi Seed Flours

Five (5) kg of each ogbonoseeds and shelled egusiseeds were cleaned, sorted, oven dried (50°C, 24 h) in a hot – air fan oven (model QUB, 30501G, Gallenkamp, UK.), and ground using a laboratory mill (Numex) Pep grinding mill, India) and screened through a 0.25 mm British Standard Sieve (model B 5410, Endecoths Ltd, London, UK). Fifteen bags each of 100gm of ogbono (Bush mango) seed flour and egusi (melon) seed flour were separately vacuum sealed in high density polyethylene bags of 0.7mm thickness as earlier reported by Akusu and Kiin-Kabari [2].

2.2.2. Frozen Storage Stability Studies

The fifteen vacuum sealed bags each of ogbono and egusi seed flours were properly labeled and stored in the domestic deep freezer at -18°C for up to 4 months. Samples were removed at intervals of 0, 1, 2, 3 and 4 months during frozen storage and were analysed for shelf-stability factors of (moisture, free fatty acid and peroxide values), selected functional properties of (water and oil absorption capacity, foam capacity and viscosity) and sensory studies.

2.2.3. Storage Studies

Moisture was determined according to AOAC [10] standard method, free fatty acid (FFA) content and peroxide value (PV) were determined using the methods described by Egan *et al.*, [11].

2.2.4. Determination of Selected Functional Properties

Ground ogbono and egusiseed flours for selected functional properties were defatted using solvent extraction in a Soxhlet apparatus (Tecator Inc. Colorado, U.S.A) for 8h

using n – hexane. Water and oil absorption capacities were determined according to the method of Beuchat [12]. Foam capacity was determined as described by Coffman and Garcia [13], viscosity was determined as described by Fleming *et al.*, [14].

2.2.5. Preparation of Ogbono and Egusi Soups

The method of Akusu & Kiin-Kabari [2] was used in the preparation of the soups. Two hundred (200g) each of ground ogbono or egusi seed flour that has been vacuum sealed and frozen for 0, 1, 2, 3 and 4 months were removed at intervals and used in the preparation of ogbono soup and egusi soup, respectively based on the recipe in Table 1 and according to the procedure outlined in Figure 1. After all the ingredients had been added, the pot was allowed to boil for 30 min to make the soups. The soup is allowed to cool, after 30 min, sensory evaluation was conducted on both soups.

Table 1. Recipe for the preparation of “Ogbono” and “Egusi” soups

Ingredients	Ogbono Soup	Egusi Soup
Ogbono seed flour	200g	-
Egusi seed flour	-	200g
Palm oil	60 ml	60 ml
Dry fish	130g	130g
Dry pepper	3g	3g
Onion	10g	10g
Flavour cubes	3 cubes	3 cubes
Salt	To taste	To taste
Water	1 litre	1 litre

Source: Akusu and Kiin-Kabari [2].

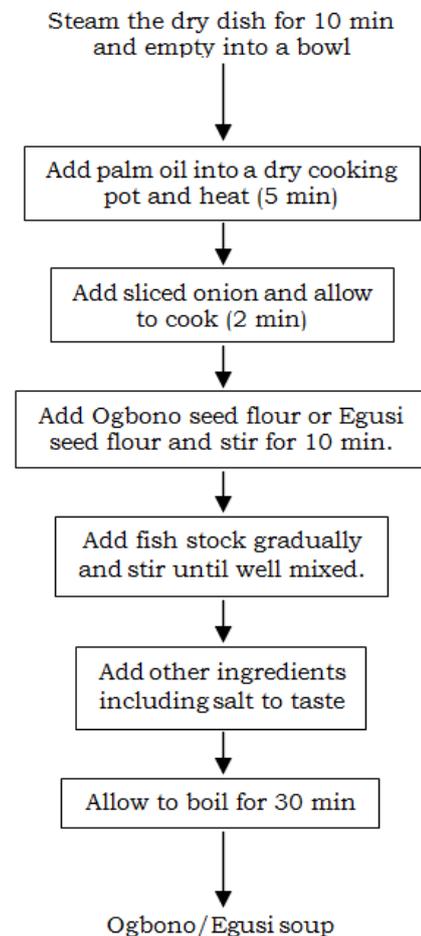


Figure 1. Flow chart showing the preparation of Ogbono / Egusi Soup

2.2.6. Sensory Analysis

A panel of twenty-five consumers comprising of staff and students of the Department of Food Science and Technology, Rivers State University of Science & Technology Port Harcourt, Nigeria was used to evaluate the sensory properties of ogbono (Bush mango) soup and egusi (melon) soup prepared from their respective seed flours that were frozen at -18°C for 0, 1, 2, 3 and 4 months. The panelists were selected based on their familiarity with sensory qualities of ogbono and egusi soups. A nine – point hedonic scale was used to evaluate appearance, taste, aroma, thickness and overall acceptability of the soups, where 1 and 9 represents dislike extremely and like extremely, respectively according to Iwe [15] method. Samples that obtained 80% of the scores in the like (6 – 9 points) hedonic region for appearance, taste, aroma, thickness and overall acceptability were considered acceptable. Water was provided to rinse the mouth between evaluations. The panelists were served the ‘ogbono’ and ‘egusi’ soups in the Food and Nutrition Laboratory of the Food Science & Technology Department at a room temperature ($28 \pm 2^{\circ}\text{C}$).

2.2.7. Statistical Analysis

The data obtained were subjected to analysis of variance (ANOVA) using Statistical Package for Social

Science (SPSS) version 20.0 software 2011. All analysis was done in triplicate and means separated using Duncan Multiple Range Test.

3. Result and Discussions

3.1. Effect of Frozen Storage on the Functional Properties of Ogbono and Egusi Seed Flours

Effect of frozen storage on selective functional properties of water/oil absorption, foam capacity and viscosity of vacuum sealed packaged ground ogbono and egusi (melon) seed flours stored for four months in a domestic deep freezer at -18°C is shown in Table 2 and Table 3. There was no significant ($P > 0.05$) difference in the selected functional properties of both ogbono and egusi seed flours frozen for up to three months, however all the selected functional properties of both flour samples decreased significantly ($p < 0.05$) after four months of frozen storage. This observation is in agreement with the work of Fellows [8], who stated that at normal frozen storage temperatures of approximately -18°C , there is a slow loss of quality owing to both chemical changes in some foods and enzymic activities.

Table 2. Effect of Frozen Storage on the Selected Functional Properties of ‘Ogbono’ Seed Flour

Months	Selected Functional Properties			
	Water Absorption Capacity (g/g)	Oil Absorption Capacity (g/g)	Foam Capacity (ml)	Viscosity (pa/s)
0	141.69 ^a	75.38 ^a	3.05 ^a	25.76 ^a
1	142.15 ^a	75.73 ^a	3.05 ^a	25.75 ^a
2	142.70 ^a	76.02 ^a	3.15 ^a	25.68 ^a
3	142.79 ^a	75.89 ^a	3.20 ^a	25.34 ^a
4	136.03 ^b	72.40 ^b	2.45 ^b	22.35 ^b

^{abc}Means with different superscripts within the same column are significantly different ($P < 0.05$).

Table 3. Effect of Frozen Storage on the Selected Functional Properties of ‘Egusi’ Seed Flour

Months	Selective Functional Properties			
	Water Absorption Capacity (g/g)	Oil Absorption Capacity (g/g)	Foam Capacity (ml)	Viscosity (pa/s)
0	118.36 ^a	84.85 ^a	3.55 ^a	11.42 ^a
1	118.35 ^a	84.79 ^a	3.54 ^a	11.44 ^a
2	118.36 ^a	84.63 ^a	3.55 ^a	11.43 ^a
3	118.30 ^a	83.98 ^b	3.25 ^a	11.21 ^a
4	116.74 ^b	82.66 ^c	2.04 ^b	9.32 ^b

^{abc}Means with different superscripts within the same column are significantly different ($p < 0.05$).

3.2. Effect of Frozen Storage on the Chemical Stability of Ogbono and Egusi Seed Flours

The effect of frozen storage on the shelf-stability properties of moisture, free fatty acid content and peroxide values of ogbono and egusi seed flours frozen up to four months is presented in Figure 2A and 2B. There was no significant ($P > 0.05$) difference in the moisture content, free fatty acid content and peroxide value of “ogbono” and “egusi” (melon) seed flours frozen for up to three months but there was a significant difference ($P < 0.05$) in the shelf-stability parameters of both ogbono and egusi seed flours after four months of frozen storage. The demand by consumers of high quality foods having fresh or natural characteristics that require minimum amount of preparation, has led to the development of ready – to – cook and convenience foods that are preserved using mild technologies such as frozen storage [8]. Erickson [16]

reported the effects of lipid oxidation on the quality of frozen foods. He stated that oxidation of lipids takes place slowly at 18°C and causes off–odours and off–flavours, hence the storage life of fatty foods is more limited than non-fatty foods. There was a significant ($p < 0.05$) decrease in the shelf-stability parameters observed in the ogbono and egusi seed flours after four months of storage and could be attributed to the slow diffusion of oxygen through the gas – impermeable polyethylene bag of 0.7mm thickness used in packaging the ogbono and egusi seed flour. Egan *et al.*, [11] reported that acidity and a rancid taste often begins to be noticeable in foods when free fatty acid content is about 0.5 to 1.5% oleic acid and peroxides values are between 20 to 40 mEg/kg. The result obtained in this study reveals that after four months of frozen storage, the free fatty acid contents of both “ogbono” and “egusi” seed flours were slightly above the safe limit while the peroxide values were still within the safe limit.

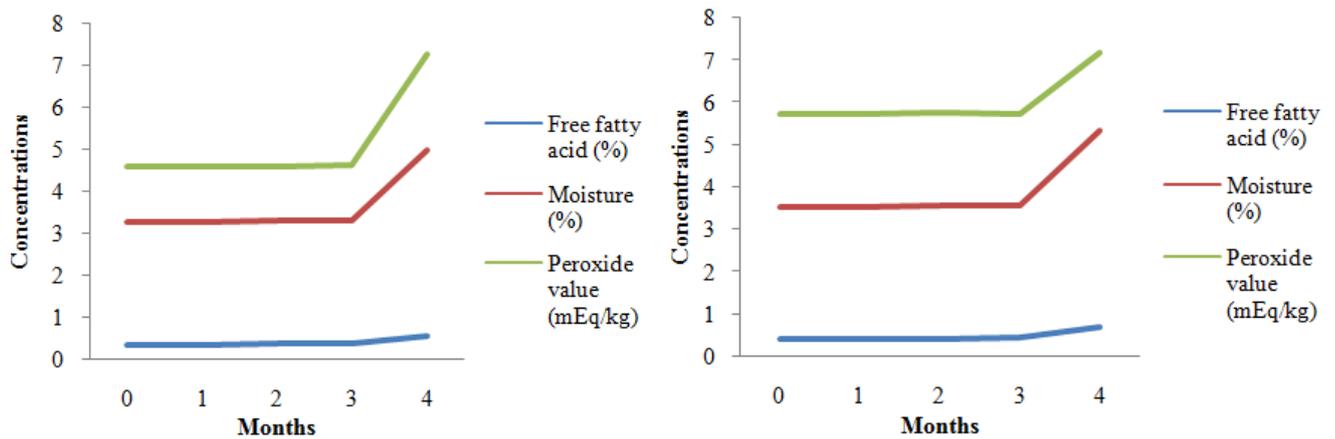


Figure 2A. Effect of frozen storage on chemical stability of ogbono seed flour, B: Effect of frozen storage on chemical stability of egusi seed flour

3.3. Effect of Frozen on the Sensory Properties of Ogbono and Egusi Seed Flours

The effects of frozen storage on the sensory properties of soups prepared from frozen packed ‘ogbono’ and ‘egusi’ (melon) seed flours are shown in Table 4 and Table 5. There was no significant ($p > 0.05$) difference in the sensory properties of soups prepared from “ogbono” and egusi seed flour frozen up to two months. However, after three months of frozen storage, there was a significant decrease ($p < 0.05$) in sensory attributes of taste, aroma, thickness, drawability and overall acceptability of “ogbono” seed flour. While the sensory attributes of taste,

aroma, thickness and overall acceptability of egusi (melon) seed flour, decreased significantly ($p < 0.05$) after three months of frozen storage. Cardello [17] stated that to the consumer, the most important quality attributes of food are its sensory characteristics. He concluded that sensory attributes substantially influence the acceptability of foods. He further stated that the aim of a food processor is to find improvement in processing technology which retains or create desirable sensory qualities. Fellows [8] stated that frozen storage is used to an extent to retain the shelf life of fresh and processed foods which causes minimal changes to sensory characteristics and nutritional properties of foods.

Table 4. Effect of Frozen Storage on Sensory Properties of “Ogbono” soup prepared from frozen ‘Ogbono’ Seed Flour

Months	Sensory Attributes					
	Appearance	Taste	Aroma	Thickness	Drawability	Overall acceptability
0	7.80 ^a	7.60 ^a	6.80 ^a	7.65 ^a	7.55 ^a	7.45 ^a
1	7.76 ^a	7.62 ^a	6.80 ^a	7.62 ^a	7.52 ^a	7.40 ^a
2	7.75 ^a	7.61 ^a	6.76 ^a	7.60 ^a	7.46 ^a	7.38 ^a
3	7.35 ^a	6.62 ^b	5.53 ^b	6.46 ^b	6.15 ^b	6.68 ^b
4	6.48 ^b	4.58 ^c	4.41 ^c	4.04 ^c	4.23 ^c	4.26 ^c

^{abc}Means with different superscripts within the same column are significantly different ($P < 0.05$).

Table 5. Effect of Frozen Storage on Sensory Properties of “Egusi” soup prepared from frozen ‘Egusi’ (melon) Seed Flour

Months	Sensory Attributes				
	Appearance	Taste	Aroma	Thickness	Overall acceptability
0	7.85 ^a	7.55 ^a	67.30 ^a	7.40 ^a	8.56 ^a
1	7.83 ^a	7.54 ^a	7.30 ^a	7.39 ^a	8.56 ^a
2	7.83 ^a	7.52 ^a	7.28 ^a	7.38 ^a	8.55 ^a
3	7.80 ^a	6.40 ^b	7.22 ^a	7.34 ^a	8.53 ^a
4	6.05 ^b	5.14 ^c	5.53 ^b	6.15 ^b	6.22 ^b

^{abc}Means with different superscripts within the same column are significantly different ($P < 0.05$).

4. Conclusion

The results obtained from this study, showed that there was no significant difference ($p > 0.05$) in shelf stability properties, selected functional and sensory properties of both ogbono and egusi seed flour frozen up to three months. However, all the shelf-stability properties, selected functional and sensory properties of both the ogbono and egusi seed flours decreased significantly ($p < 0.05$) after four months of frozen storage. Therefore, frozen storage at -18°C could be used to preserve the storage life (shelf-stability), functional and sensory

properties of vacuum packaged ‘ogbono’ and ‘egusi’ seed flours up to three months in moisture/gas-impermeable polyethylene packs of 0.7mm thickness without losing its sensory properties.

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