

Functional Properties and Proximate Composition of Asparagus Bean (*Vigna Sesquipedalis*) as Influenced by Malting

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Abstract: Whole Asparagus bean (*Vigna sesquipedalis*) was subjected to soaking in tap water for 12 hours and 24 hours. Each portion was malted for 48, 60 and 72 hours and then dehulled, dried and milled into flour. The proximate composition and the functional properties were determined for each of the samples and the result showed that protein content was highest in samples soaked for 24 hours and malted sample (MS) for 72 hours (23.90%). The sample soaked for 12 hours and malted for 72 hours had 22.95% while the unmalted samples had 22.26% protein content. Ash, fibre and moisture contents of the samples soaked for 12 hours and malted for 72 hours ranged from 2.42%, 1.97% and 16.00%, respectively and that for sample soaked for 24 hours and malted for 72 hours ranged from 2.20%, 1.82% and 17.70%, respectively while the unmalted sample gave 2.98%, 2.24% and 8.26%, respectively. Malting increased foam capacity from 16.00 to 18.05%, water absorption capacity from 1.35% to 1.98% emulsion capacities from 29.20 to 29.98% and bulk densities were (0.75 to 0.98%). The nutritive and functional properties of raw beans were slightly improved by malting. As a result of this improvement in both the proximate and functional properties of the flour, it could be incorporated in various foods to improve their nutritional value. [Journal of American Science 2010;6(9):376-382]. (ISSN: 1545-1003).

Key words: functional properties, proximate composition, malting

1. Introduction

Asparagus bean (*Vigna sesquipedalis*) belong to the family *leguminosea* and sub family *papilionadea sp.* According to Desphande *et al.*, (1982), plants are the most important source of food and food protein for human consumption and observed that of the total world food harvest, plant products contribute approximately 81.8% of the tonnage, whereas animal and marine products together contribute only 16.8%. Like many other legumes, Asparagus beans are important sources of dietary protein which complement protein obtained from cereals, animal and marine products.

According to Abel (1985), the bean is mostly grown in Far East, mostly for its immature pods. When matured, are elongated, kidney shaped and black in colour. Locally, Asparagus bean is known as black 'akidi' (Enwere, 1998). Asparagus bean is produced and eaten in many parts of Southern Nigeria like Enugu and Anambra States. The matured seeds are consumed in a variety of ways such as whole or dehusked seeds, cooked in boiling water for varying period and consumed after addition of salt and spices. It can also be processed into flour. It can as well be prepared into moin-moin and akara (Ezueh, 1994).

However, malting provides starch and protein as basis of the fermentation medium and these substances are converted to fermentative sugars and dextrans and to amino acids and other products of protein degradation by the actions of indigenous amylolytic and proteolytic enzymes, respectively (Uzuegbu and Eke,

2000). Also malting of beans before consumption leads to a marked increase in their soluble vitamin content, including ascorbic acid in form of vitamin C which is virtually absent in the dry seed (Abel, 1985). Subjecting beans to a soaking process causes softening of the seeds, reduces nutrient loss and eliminates toxic substances. Also malting improves the nutritive value of beans mainly by reducing the phytate content (Ihekoronye and Ngoddy, 1985).

Lack of knowledge of the functional, chemical and nutritional properties of legumes grown in developing countries are responsible for the limited use of these crops in different food formulations. With adequate analysis, Asparagus bean can be easily blended into existing diets without major changes in the consumption pattern of the people (Akobundu *et al.*, 1982). The study was aimed at investigating the effect of malting on the proximate and functional properties of Asparagus bean with the view of exploiting some of the possible food uses.

2. Materials and Method

2.1 Materials Collection and Preparation

The dry seeds of Asparagus bean (*Vigna sesquipedalis*) used in this work was bought from a local market in Enugu Local Government Area of Enugu State.

The equipments that were used in this work were obtained from the Department of Food Science and Technology Laboratory, Federal University of Technology, Owerri.

The dry raw seeds were cleaned and sorted to remove the unwholesome seeds. One kilogram of the cleaned wholesome seed was malted by soaking in tap water for twelve hours (12 hr) at the ratio of 1:2. They were later germinated by spreading out in a jute bag and covered with another jute bag and then sprinkle water on it daily until it started sprouting out or germinating.

It is then dehulled prior to oven drying at the temperature of 60°C for 6 hours. They were kept in a dessicator to cool, after which the samples were milled into flour and then sieved. The flour for the sample obtained were kept in an air tight container and then labeled prior to analysis of the proximate and functional properties.

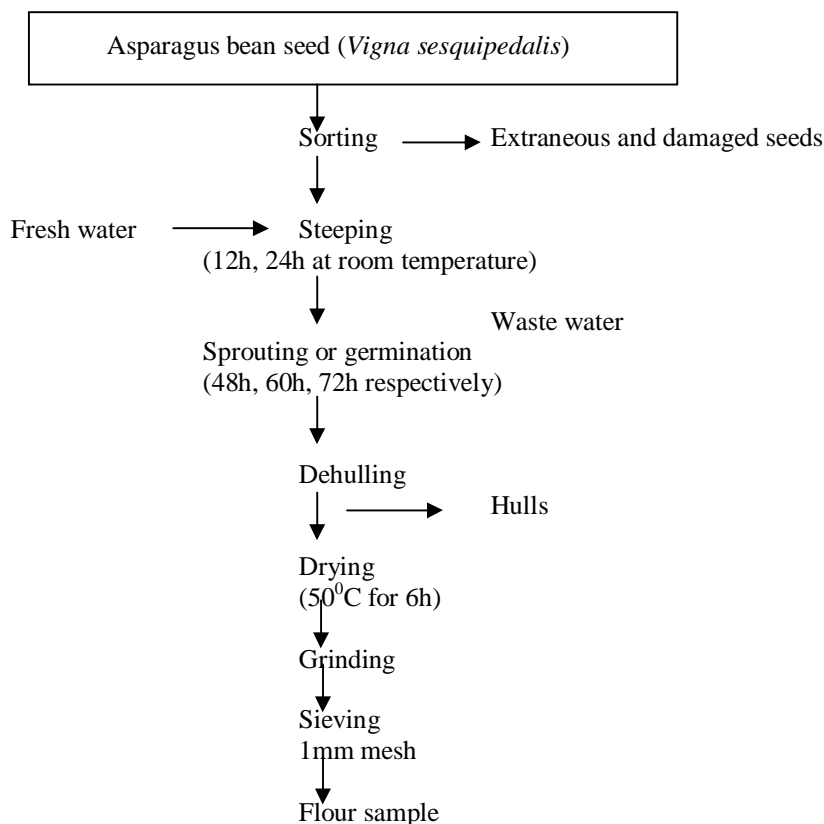


Fig 1. Flow Diagram for the Production of Malted Asparagus Bean Flour

2.2 Analysis of Proximate Composition

The proximate composition of the samples were determined according to the method of AOAC (1990)

2.3 Analysis of Functional Properties

2.3.1 Foam Capacity

Foam capacity was determined as described by Onwuka (2005). Two grams of flour sample was blended with distilled water in a microblender which was whipped at 1600 rpm for 5 min. The mixture was transferred to a 250 ml measuring cylinder. The volume of the foam was recorded and the foam capacity was expressed as percent increase in volume using the formula:

$$\text{Foam capacity} = \frac{V_a - V_b}{V} \times 100$$

V_a = Volume after whipping

V_b = Volume before whipping

2.3.2 Wettability

The wettability of the samples were determined according to the method of Okezie and Bello (1988).

2.3.3 Bulk Density

According to Okezie and Bello (1988) method which was followed for the determination of density with slight modification. The flour sample was used to fill a clean dry measuring cylinder, the bottom of the cylinder was tapped on a table until the level could fall no further at the 10 cm³ mark. The flour was transferred to a weighed dish and weighed. The weight of the flour which occupied the 10 cm³ was measured and expressed as a ratio of volume.

The bulk density was given by:

$$\text{Bulk density} = \frac{w}{V \text{ g/cm}^3}$$

Where, w = Weight of sample

V = Volume occupied by the sample.

2.3.4 Swelling Index Determination

The swelling index was determined. Three grammes of the sample was transferred into dry cleaned graduated 50 ml cylinder. The sample was gently leveled and the volume was noted. 30 ml of water was added to the sample. The cylinder was allowed to stand for 60 min, while the change in volume (swelling) was recorded every 10 mins. The swelling power of each flour sample of the bean was calculated as a multiple of the original volume.

Swelling index was calculated as:

$$\frac{\text{Average final level (for every 10 mins) of sample}}{\text{Initial level of sample}}$$

2.3.5 Gelation

This was carried out according to method of Narayana and Roa (1982).

2.3.6 Water Absorption Capacity

One gram of the flour sample was weighed into a test tube and mixed with 10 ml of distilled water. The mixture was left to stand for 30 min at room temperature and shaken every 10 min.

At the end, it was centrifuged at 10,000 rpm for 5 min. The supernatant was carefully measured to determine the volume of water absorbed and retained by the sample. The volume of water absorbed was multiplied with the density of the water to obtain the weight of water so absorbed.

$$\text{Water absorption capacity} = \frac{(V_1 - V_2)P}{\text{Weight of sample}}$$

Where V_1 = The initial volume of water used

V_2 = The volume remaining i.e. volume not absorbed

P = The density of water (1.0 g/cm^3)

2.3.7 Oil Absorption Capacity

The oil absorption capacities of the samples were determined according to method of Beuchat (1977).

2.3.8 Emulsion Capacity

Two grams of each Asparagus bean flour samples and 75 ml of distilled water were for 30 seconds using a magnetic stirrer at 1,500 rpm. After complete dispersion bleached deodourized vegetable oil was added continuously until the emulsion break point was reached. The emulsion capacities were expressed as ml of oil emulsified per g of flour. It is denoted by;

$$\text{Emulsion capacity} = \frac{V_E}{V} \times \frac{100}{W}$$

Where

W = the weight of sample

V_E = the volume of emulsion

V = the volume of mixture

3. Results and Discussion

3.1 Effect of Malting on the Proximate Composition of Asparagus Bean (*Vigna sesquipedata*)

From proximate composition result in Table 1, the unmalted seed of Asparagus bean used in this study had a crude protein content of 22.60%. The reported literature value for the protein content of seeds ranged from 15.8% to 34.7% (Ihekoronye and Ngoddy, 1985). The relatively high content of protein in Asparagus bean as found in this study suggests that a good proportion of an individual's daily protein needs may be met if the seeds are consumed in significantly large quantities.

After malting, the crude protein content of Asparagus bean soaked for 12 hours increased from the initial 22.16% - 22.95%, with the sample malted for 48 hours having the lowest, and the highest being the 72 hrs malted sample having a protein content of 22.95%. For the 24 hours soaked and malted samples, the 48 hours malted sample had the least with 23.20% protein and the 72 hours malted sample having the highest with 23.90%. This increase may be attributed to the degradation of higher molecular weight storage protein to lower fraction as a result of malting. The increase may also be due to the increase in lysine content that accompanies sprouting and to the loss in Dry Malter (DM) (Wu, 1983).

From table 1, the 12 hours and 24 hours malted samples showed that they are equal at $p < 0.05$. There is no significant difference $p < 0.05$ between the various samples.

The unmalted Asparagus bean used in this work had a fat content of 2.07%. The 12 hours soaked malted for 48 h samples had the highest value of 2.05% and the 3 days (72 hr) malted and soaked for 24 hours had the lowest value of 1.02%. The fat content decreased as malting and soaking time increased. This decrease is in agreement with the finding of Prudente and Mabesa (1981), in their studies on mungo beans, sprouted in light and dark areas. This decrease may be due to the utilization of stored lipid reserves in the endosperm portion of the seeds during germination. The lipids are also a source of carbon for the synthesis of sucrose which is ultimately transported to the growing embryo (Paul and Benedick, 1982).

The moisture content of the malted asparagus bean increased from the unmalted which had 8.26% to that of the sample soaked for 24 hours and malted for 72 hours which gave 17.70% and all the malted samples increased when compared to that of the unmalted (raw) as stated earlier. The moisture content of the various malted samples increased with increase in soaking time. This may be attributed to the increase in the intake of moisture by the bean due to soaking. There is no significant difference at $p < 0.05$ between the various malted asparagus bean.

The crude fibre for the different samples were significantly different at $p > 0.05$ for the 24 hours soaked and malted samples for the 3 different hours (i.e. 48, 60 and 72) while significant different $p < 0.05$ did not exist for the 12 hours soaked and malted samples for the 48, 60 and 72 hours. A crude fibre content of 2.20% was highest for the 12 hours samples and malted sample for 48 hours while the 24 hours soaked sample and malted for 72 hours sample had least of 1.82%. The raw sample recorded a higher crude fibre content of 2.24% within the range as recorded by (Enwere, 1998).

The ash content of 2.20% was found in the unmalted (raw) asparagus bean flour in this study. This falls within the range of ash content in legume 10 – 70% (Apatu and Ologhobo, 1990). During malting, the ash content increased from the raw 2.30% to 2.42% on the 12 hours soaking and its malting hours from (i.e. 48, 60 and 72) and also increased more from 2.60% to 2.98% on the 24 hours of soaking and its malting hours

(i.e. 48, 60 and 72). The ash content of the various malted samples increased as malting increased. There is significant difference $p < 0.05$ in the ash content between the various asparagus bean flour samples. Vijaya (1983) reported in his studies that ash content was greatest in germinated soybeans. His findings lend support to the results obtained in this work. Increase in ash content during sprouting is advantageous since ash content is the reflection of the mineral contents of seeds.

The carbohydrate value for the 12 hours soaked sample and malted samples showed significant difference at $p > 0.05$ while the 24 hours soaked sample and malted samples are the same. The carbohydrate value for the various samples decreased with soaking and malting time. The decrease may be as a result of hydrolysis of macromolecules like starch and other polysaccharides (Iroin, 1987).

Table 1: Mean Value for The Proximate Composition of Asparagus Bean

Soaking/ steeping time	Malting time (h)	Ash %	Fat %	Moisture %	Crude fibre %	Crude protein %	CHO %
Raw (N/A)	Raw (N/A)	2.20 ^a	2.07 ^a	8.26 ^c	2.24 ^a	22.26 ^a	61.52 ^a
12	48	2.30 ^a	2.05 ^a	14.40 ^a	2.20 ^a	22.30 ^a	56.44 ^b
	60	2.40 ^a	1.25 ^{bc}	15.20 ^a	2.12 ^a	22.45 ^a	56.30 ^b
	72	2.42 ^a	1.15 ^c	16.00 ^a	1.97 ^a	22.95 ^a	55.51 ^b
LSD_{0.05}		0.9759	0.1705	2.9379	0.9948	2.3091	1.5014
24	48	2.60 ^a	1.10 ^a	16.10 ^a	2.10 ^a	23.20 ^a	55.10 ^{ab}
	60	2.70 ^a	1.10 ^a	17.40 ^a	1.90 ^{bc}	23.47 ^a	53.83 ^{ab}
	72	2.98 ^a	1.02 ^a	17.70 ^a	1.80 ^c	23.90 ^a	53.36 ^{ab}
LSD_{0.05}		0.8547	0.0898	1.0294	0.1686	1.1125	18.0655

3.2 Effect of Malting on the Functional Properties of Asparagus Flour

The result of analysis of the functional properties is shown in Table 2

3.2.1 Water and Oil Absorption Capacity

From the result of water absorption capacity (WAC), the unmalted sample (raw) had the lowest value while the 12 hours soaking and 72 hours malted sample had the highest WAC of 1.78%. The 24 hours soaked sample and the 72 hours malted sample had the highest water absorption capacity (WAC) of 1.98%. The water absorption capacity for various samples increased as soaking time and malting time increased. According to Abbey and Ibeh, (1988) the higher water uptake by the malted sample compared to the control, might be due to the presence of more protein or more hydrophilic polysaccharides in the malted sample. The WAC of Asparagus flour are comparable to that of sunflower flour (1.8 g/g) as reported by Sosluski and Fleming (1977). Significant different $p < 0.05$ exist based on malting of the various samples.

The oil absorption capacity of the control (raw) is 1.20% as reported by Narayana and Rao, (1982) and subsequently increased with malting time. This suggests that Asparagus bean flour contain more hydrophobic protein which shows superior binding of lipids. The 72 hours malted samples for both the 12 and 24 hours soaked samples had the highest oil absorption capacity (OAC) of 1.33% and 1.51 respectively which was significantly different at $p < 0.05$ with others.

Since oil act to retain flavour and increase the mouth feel of foods, oil absorption is an important property in sauce food formulations.

3.2.2 Emulsion Capacity

From the result in Table 2, the emulsion capacity increased with increase in malting time with the 24 hours soaked and malted sample for 72 hours have the highest emulsion capacity of (29.98 cm³) and the least being the sample soaked for 24 hours and malted for 48 hours (27.25%). The sample soaked for 12 hours and malted for 72 hours have a higher emulsion capacity of (29.45%) and that of the sample soaked for the same

hour (i.e. 12 hours) and malted for 48 hours have a lower emulsion capacity of (29.20%). The raw had the least emulsion capacity of (29.10%) when compared to the malted samples.

Sprouting has been found to modify the protein content of soybean. On the increase in the emulsion capacity of the malted sample, it could be as a result of a higher protein content of the malted sample when compared to the unmalted (raw) sample and also due to the hydrophilic and hydrophobic amino acid of the protein (Abbey and Ibeh, 1988).

3.2.3 Foam Capacity

Result from table 2 showed that the raw sample (unmalted) had the highest foam capacity 17.94 cm³ when compared to the 12 hour soaked and malted samples. For the 24 hour soaked and malted samples, the 48 hour malted had the least of (16.92 cm³) while the 72 hour malted sample have the highest of (18.05 cm³). The foam capacity increased with malting time. According to Sathe and Salinkhe (1981), proteins are utilized to form a stable form by unfolding of the polypeptide chains and exposing substantial region of hydrophobic residue into air in lipid phase where they form a good foam capacity and stability. Hence the increase in the foam capacity of the 72 hours malted sample had the highest protein content. The variations caused by malting are not significantly different $p > 0.05$ for the various processed samples.

3.2.4 Swelling Index (S.I)

The result from Table 2 showed that malting have a significant effect $p < 0.05$ on the swelling index of the samples. The raw sample (unmalted) have the highest swelling index of (1.59 cm³) when compared to the malted samples. The S.I. of the samples decreased with increase in malting time. It may be because germination brought about a decrease in the content of starch, amyloses and non reducing sugar. Hence the decrease in the swelling index of the malted samples could be attributed to the lower carbohydrate content when compared to the unmalted sample raw.

3.2.5 Bulk Density and Wettability

The 24 hours soaked sample and malted for 72 hours have the highest bulk density of (0.98 kg/m³) and the unmalted sample (raw) with the least value of (0.72 kg/m³). The bulk density increased with soaking and malting time for the various processed samples. There

was a significant difference $p < 0.05$ between the various samples.

Wettability is time dependent. The raw sample (unmalted) have the highest wettability while the 24 hours soaked sample and malted for 72 hours have the least wettability (42.00 min). The wettability decreased with increase in the soaking time on the malted samples. Significant difference $p > 0.05$ exist for the various malted samples. The decrease in the wettability may be due to disruption of the nature of the molecule in the malted sample which resulted to low interfacial tension between the particles and the liquid (Elemo and Adu, 2005).

3.2.6 Gelling Point

The result in table 2 showed that gelling point varied from (81 – 93⁰C). The gelling point of the 24 hours soaked and malted for 60 hours and 72 hours recorded the highest gelling point and the same 24 hours soaked sample and 48 hours malted recorded the least gelling point (92⁰C). The unmalted sample has the smallest gelling point (81⁰C). The 12 hours soaked samples and malted for 48, 60 and 72 hours have their gelling points in therange of 90, 92 and 92 respectively. The high gelling point for malted samples could be as a result of high protein content. Sathe *et al.*, (1982) associated the variation in gelling properties to different constituents – proteins, lipids, and carbohydrate that makes up the legume protein was attributed to globulin fraction and gelling point is indeed on aggregation of denatured molecules. This suggests that this property would make proteins suitable in food systems such as pudding, sauces and moi moi which require thickening and gelling properties. And significant differences $p > 0.05$ exist for the various malted samples.

3.2.7 Boiling Point

The boiling point for the various samples ranged from 95 – 99⁰C. The boiling point of the 24 hrs soaked and 72 hours malted samples recorded the highest (99.00⁰C) while the raw sample had the least boiling point. Significant difference $p < 0.05$ did not exist within the various malted samples. The higher boiling point of the malted sample could be associated with the relative ratio of different constituent: protein, carbohydrate and lipid that was left after processing (Sathe *et al.*, 1982).

Table 2: Mean Values for The Functional Properties of Asparagus Flour

Steeping time of soaking time (h)	Malting time (h)	Bulk density (kg/m ³)	Wettability (min)	Gelling point (⁰ C)	Boiling point (⁰ C)	Swelling Index (cm ³)	Emulsion capacity (cm ³)	Oil absorption Capacity (ml/g)	Water absorption Capacity (ml/g)	Foam capacity (cm ³)
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Raw (N/A)	Raw (N/A)	0.72 ^a	189.00 ^a	81.00 ^a	95.00 ^a	1.59 ^a	29.10 ^a	1.20 ^a	1.25 ^a	17.94 ^a
	48	0.75 ^a	51.00 ^a	90.00 ^a	96.00 ^a	1.54 ^a	29.20 ^a	1.24 ^b	1.35 ^{ab}	17.94 ^a
12	60	0.77 ^a	56.00 ^a	92.00 ^a	97.00 ^a	1.56 ^a	29.22 ^a	1.29 ^a	1.55 ^a	16.00 ^b
	72	0.78 ^a	59.00 ^a	92.00 ^a	97.00 ^a	1.57 ^a	29.45 ^a	1.33 ^a	1.78 ^a	17.81 ^a
LSD _{0.05}		0.0402	3.8122	7.9865	5.6829	0.1321	0.3871	0.4358	0.2477	1.1344
	48	0.91 ^a	43.00 ^a	92.00 ^a	95.00 ^a	1.57 ^b	27.25 ^a	1.15 ^c	1.45 ^{ab}	16.92 ^{ab}
24	60	0.92 ^a	43.00 ^a	93.00 ^a	97.00 ^a	1.57 ^b	27.30 ^a	1.42 ^a	1.62 ^a	17.93 ^a
	72	0.98 ^a	42.00 ^a	93.00 ^a	99.00 ^a	1.58 ^a	29.98 ^a	1.51 ^a	1.98 ^a	18.05 ^a
LSD _{0.05}		0.0539	3.2398	5.8233	4.1159	0.0254	0.9114	0.2749	0.5165	1.2388

4. Conclusion

The results obtained from this work showed that Asparagus flour could be a good substitute for flour from other legumes, such as soybean, cowpea, in some food formulations.

The result obtained from the proximate composition has shown that malting can be used to improve the nutritional content of Asparagus seed. However, malting of Asparagus seeds for nutritional purposes should not be allowed to go beyond 72 hours.

The result for the functional properties showed that malting improved and modified the functional properties of the Asparagus bean. Malting improved the emulsion, water and oil absorption capacity of the flour which are important parameters in food formulation. Hence, data from the functional properties will give a guide to the use of the flour for some food product.

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