

EFFECT OF SALT APPLICATIONS ON SOME FUNCTIONAL PROPERTIES OF BAMBARA GROUNDNUT (*VIGNA SUBTERRANEA*) SEED FLOUR

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Abstract

The effects of salt applications on the functional properties of *Vigna subterranea* flour were investigated using standard methods. The salts used were NaCl, KCl, Na₂SO₄ and K₂SO₄. The least gelation concentrations of 10.0% in free salt solutions were improved to between 6.0%-8.0% in the presence of the salts used. The water absorption capacity of 186.7% decreased at various salt concentrations compared with value in distilled water but consistency of improvement was found in Na₂SO₄. The foaming capacity of 61.8% in distilled water was improved from 61.8% to 65.3% depending on the type and level of salt used. Foaming stability value after 4h were type of salt and salt concentrations dependent. The oil emulsion capacity depended mostly on the salt concentration and the type of salt under consideration while oil emulsion stability is better at higher salt concentrations between 5.0% -10.0% (W/V) than lower salt under consideration for the studied sample.

Keywords: Functional properties, *Vigna subterranea* flower, Salt..

Introduction

Plant proteins are being investigated and tested for new products such as low cost formulated food which are nutritious, attractive and acceptable to consumers just like conventional foods from meat, fish and dairy products (Lawhom & Cater, 1971; Lin *et al.*, 1974; Mc Walters and Cherry 1977). Research attention that has been directed towards utilization of plant protein sources for food use, include lima bean (Oshodi & Adeladun, 1993), cowpea (Olaofe *et al.*, 1993) pigeon pea (Oloyo, 2002), fluted pumpkin (Fagbemi *et al.*, 2006), Gila bean (Siddhuraju *et al.*, 2001).

The success of utilizing plant protein as ingredient depends largely upon the beneficial qualities they impart to food which depend largely on their functional properties (Aluko & Yada, 1995). These functional properties of protein depend largely on a number of factors among which is salt concentration. Some salts have been found to influence the functional properties of protein (Ogundele *et al.*, 2002). Sodium chloride or table salt at appropriate concentration aids foaming presumably by aiding diffusion and spreading at the interface (Troberg, 1979), however, this is concentration dependent but high level of salt depresses foaming. At high concentration a reduction in hydration may occur (Kuntz 1971, Bull & Breese 1976). Fleming *et al.*, (1974) reported that 5% salt enhanced the water holding capacity of soy flour but reduced that of soy isolate.

Bambara groundnut has significant nutritional value which is comparable with milk products. It is rich in protein, carbohydrate and fibre content (Mazahib *et al.*, 2013; Minka & Brunetean 2000). This article is designed to study the effect of salt types and their concentration on some functional properties of Bambara groundnut flour.

Materials and methods.

Mature seeds of *Vigna subterranea* were purchased from a local market in Ilaro. The seeds were sun-dried and milled into flour in a Wiley mill to pass through an 80-mesh sieve, stored in an air-tight container and kept in a refrigerator at 4 °C prior to use.

The effect of salt applications on some of the functional properties of the sample were determined as described by Ogundenle *et al.*, (2002), Oshodi and Ojokan (1997). The salts used were NaCl, KCl, Na₂SO₄ and K₂SO₄.

The required concentration of the various salt solutions used are 0.5%, 1.0%, 2.0%, 5.0% and 10%.

Results and Discussion

Table 1: Salt Effect on the Least Gelation Concentration of *Vigna subterranean* seed flour

Salt concentration %	(%)			
	NaCl	KCl	Na ₂ SO ₄	K ₂ SO ₄
0.0	10	10	10	10
0.5	8	8	8	8
1.0	8	8	8	8
2.0	6	6	8	8
5.0	6	8	6	8
10.0	6	8	6	6
Mean	7.3	8	7.7	7.7

Effect of salt concentration on least gelation concentration.

Table 1 indicates the effect of salt concentration on least gelation concentration. The least gelation concentration of *Vigna subterranean* was 10% w/v in distilled water. The addition of salt decreased the gelation concentration and was found to be dependent on salt concentration and types of salt used. Values obtained ranged from 6%-8%. The addition of different salts at low concentration of 2% improved the gelation property of the flour by lowering the gelation concentration. Lowering of the gelation concentration by the addition of salt at appropriate salt concentration have been reported for Lupin seed (England, 1975), cashew nut flour (Fagbemi et al., 2004) and Guinea (Ogungbunle et al., 2009).

Table 2: Salt Effect on water absorption capacity (%) of *Vigna subterranea* seed flour.

Salt concentration %	NaCl	KCl	Na ₂ SO ₄	K ₂ SO ₄
0.0	186.7	186.7	186.7	186.7
0.5	183.8	181.7	180.0	183.3
1.0	176.6	175.0	166.7	168.3
2.0	171.7	170.0	161.7	168.3
5.0	163.3	160.6	156.7	155.0
10.0	158.3	161.6	155.0	151.7
Mean	173.3	172.7	167.8	168.1

Effect of salt concentration on water absorption

Table 2 depicts variations in water absorption capacity of bambara groundnut flour at various salt concentrations and among different salts. The water holding capacity in distilled water was found to be 186.7%. This value was higher than those reported for soy flour (130%) and sunflower (107%) (Lin et al., 1974), and Guinoa (147%) (Ogungbenle et al., 2003). The higher water absorption capacity by the seed flour may suggest that they are more hydrophilic in nature (Lin et al., 1974). The high water holding of *Vigna subterranea* may make it more susceptible to heat denaturation (Kinsella et al., 1985). Table 2 also shows a progressive decrease in water holding as the concentration of the salt increases. The lower water holding at high salt concentration may be an advantage in drying and storage stability of *Vigna subterranea* flour and its products.

Table 3: Foaming capacity (%) of *Vigna subterranea* seed flour in various salt concentration

Salt concentration %	NaCl	KCl	Na ₂ SO ₄	K ₂ SO ₄
0.0	61.8	61.8	61.8	61.8
0.5	65.3	64.7	61.9	62.0
1.0	65.4	64.9	61.2	62.5
2.0	51.9	50.8	46.5	45.7
5.0	39.6	40.9	35.5	33.5
10.0	33.2	33.9	31.7	30.5
Mean	52.9	52.8	49.9	49.3

Table 4 Foaming Stability (%) of *Vigna subterranea* seed flour in various salt concentrations

Salt concentration %	NaCl	KCL	Na ₂ SO ₄	K ₂ SO ₄
0.0	38.5	38.5	38.5	38.5
0.5	36.2	35.9	37.1	36.8
1.0	32.6	31.7	33.2	31.4
2.0	23.5	22.6	20.7	21.0
5.0	20.4	19.7	18.6	18.2
10.0	16.1	15.2	13.7	13.0
Mean	27.9	27.3	26.9	26.5

Effect of salt concentration on foaming properties

The effect of salt concentration on foaming is presented in Table 3. Low foaming capacity existed within salt concentration as show in the table 3 for NaCl and KCl, there is an increase in the foaming capacity with increase in concentration of the salt from 0.5% to 2.0% and there is a drop at 5.0% salt concentration. Low foaming capacity existed within salt concentration fo NaCl and KCl. The high concentration of different salts enhance protein solubility where as high concentrations decrease it (Narayana and Narasinga 1984, Akintayo et al 1999 & Ogungbenle et al 2009). The improved foaming capacity in the presence of salts may consequently improve the functionality of *Vigna subterranean* and its uses for the production of cakes (Johnson et al., 1979; Lee et al., 1993). Foam stability is important since success of a whipping agent depend on its ability maintain the whip as long as possible.

The result of foaming stabilities after 4hours are show in Table 4, showed that all salts used at different concentrations significantly decrease the foam properties of *Vigna subterranea*.

Table 5: Emulsion capacity (%) of *Vigna subterranea* seed flour in various salt concentrations

Salt concentration %	NaCl	KCL	Na ₂ SO ₄	K ₂ SO ₄
0.0	0.31	0.31	0.31	0.31
0.5	0.32	0.30	0.30	0.30
1.0	0.29	0.28	0.28	0.28
2.0	0.24	0.25	0.26	0.27
5.0	0.20	0.21	0.21	0.20
10.0	0.18	0.19	0.18	0.17
Mean	0.26	0.26	0.26	0.26

Table 6: Emulsion stability (%) of *Vigna subterranea* seed flour in various salt concentrations

Salt concentration %	NaCl	KCL	Na ₂ SO ₄	K ₂ SO ₄
0.0	43.7	43.7	43.7	43.7
0.5	41.7	40.7	39.0	41.7
1.0	37.3	35.7	36.0	35.3
2.0	31.7	30.0	30.3	28.7
5.0	27.3	27.0	23.3	24.0
10.0	23.7	24.3	21.0	19.7
Mean	34.23	35.56	32.22	32.18

Effect of salt concentrations on emulsion capacity/stability

The emulsion capacity and stability of *Vigna subterranean* are presented in Tables 5 and 6 respectively. The results show that emulsion capacity and stability depend on the types and the concentration of salt under consideration. Table 6 indicates that after 4hrs the quantity of water separated from emulsion produced increased with the concentration of the salt under consideration, indicating a decrease in emulsion stability in the presence of salts. The degree of water separation varies from salt to salt. The decrease in emulsion stability in the present work may be due to increase contact leading to coalescence which thereby reduces stability (Ogungbenle *et al.*, 2002). From the table it can be seen that the higher the concentration of the salt the higher the volume of water separated.

Conclusion

The results show that the water absorption capacity, emulsion capacity/stability, foaming capacity/stability and least gelation concentration of the studies sample are influenced by salts and these depend on the functional properties of *Vigna subterranea* flour.

Recommendation

More interest should be directed toward the usage of this proteinous seed especially, in its incorporation into non- proteinous food as this improve the protein content while at the same time reflecting its functional properties.

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