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Effects of soaking on shelflife of soybean fullfat flour

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ABSTRACT

Background: Soy products are gaining popularity as economical protein sources and nutritional or health foods. Processing that ensures improved shelf life is essential to enhance its use in alleviating malnutrition. Shelf life studies were carried out on Soybean full - fat flour samples produced from soybean soaked in different solutions.

Methods: Soybean seeds were soaked, drained, steam bleached (100°C) for 45 minutes, dehulled, dried in a cabinet drier and subsequently milled. The flour samples were stored and quality parameters (moisture content, ash content, protein content, crude fibre content, fat content, carbohydrate content and free fatty acid content) were determined at an interval of four weeks over a period of 12 weeks.

Result: The crude fibre content of the chemically treated samples ranged from 5% to 12% over the 12 - week storage period. The moisture content of the control sample was 14% at the end of the storage period while that of the chemically treated samples were 12%, 6%, 8% for sodium carbonate, sodium bicarbonate and sodium chloride respectively. Soaking in 5% w/v sodium bicarbonate solution yielded a shelf stable soybean full fat flour. Sodium bicarbonate treated sample had the least free fatty acid content.

Conclusion: Soaking sobean seeds in chemical solutions before processing reduced peroxidase action on the samples which was evident in the low free fatty acid content of the samples towards the end of the shelf life period.

Key words: soybean seeds, fullfat flour, shelflife, soaking.

INTRODUCTION

The shelf life of a food is the time it takes a product to decline to an unacceptable level. The actual length of the shelf life of any given product will depend on a number of factors such as processing method, packaging and storage conditions. Keeping quality or storage stability is measured under storage and handling conditions that are set up to stimulate or somewhat exceed the conditions the product is expected to encounter in normal distribution and use. As normal storage tests may require a year or longer to be meaningful, it is common to design accelerated storage tests. These usually involve extremes of temperature, humidity or other variables to show up developing quality defects in a shorter time (Potter and Hotchkiss, 1995; Nelson *et al.,* 1976).

Soybean is an excellent source of dietary protein for human food providing complete human requirement of almost all the amino acids. It is also an excellent source of minerals and vitamins (Aworh *et al.,* 1987; Igyor *et al.,* 2006). Recently, many functions of soybeans have been in the spotlight, for example, reducing the risks of heart disease, cancer and so on (Messina *et al.,* 1994).

Soybean is an excellent source of quality protein and compares well with animal protein in essential amino acids (Liu, 1997). Soybean is a concentrated source of vegetable proteins; it contains about 40% protein and 20% oil. Proteins are abundantly rich in lysine which is a limiting amino acid in most of the cereals. Soybean fat being highly unsaturated has been found to be nutritionally desirable. Therefore, it can easily supplement the diet of the poor (Yadav and Chauhan, 2005; Yadav *et al.,* 2003; Yadav *et al.,* 2007; Yadav *et al.,* 2008). Protein and oil contents of soybean are much higher than those of common pulses. The oil content is also high in proportion of unsaturated fatty acids (about 85%) making it healthy oil (USDA, 1990).

Soaking (steeping) can be defined as the immersion of seeds (legumes, cereals, grains etc) in any fluid. Soaking helps in softening of the seed bran that helps in dehulling operations and aids further processing. Soaking and cooking of beans are separate functions that may or may not be performed simultaneously. In some processes, the beans are soaked to saturation with water before heat is introduced to facilitate quicker cooking. Furthermore, soaking prior to cooking reduces the concentration of toxic factors and flatulence inducing sugars (stachyose and raffinose) and gives a softer final texture to the cooked beans (Kobayashi *et al.,* 1995; Larmond, 1992; Torres-Penaranda and Reitmeier, 2001).

When soybean seeds are soaked and ground, lipid hydroperoxidation is rapidly promoted. Wilson (1996) reported that grinding soybeans at high temperature is effective to control lipoxygenase activities and results in reducing off-flavor generation. It has been shown scientifically and quantitatively that grinding soybeans at low and high temperatures, 3ºC and 80ºC, respectively, is very effective in reducing hydroperoxidation and off-flavor contents (Mizutani and Hashimoto, 2004).

Soybeans foods such as soy flour, soymilk, tofu and textured soy protein are gaining popularity as economical protein sources and nutritional or health foods (Akinyele *et al.,* 1999; Omeirie and Ogbonna, 2006). Soy flour is a good protein source and is used to improve the colour, texture and water-binding capacity in baked products. The flavor quality of soy flour has been reported to affect the consumer acceptance of the final products (Kobayashi *et al.,* 1995). Soybean full fat flour is produced from the unextracted, dehulled beans containing about 18% to 20% oil. This is the simplest of all edible soybean protein products and is in high demand all over the world. However, defatted soya flour is a product of technology that has been available for years. Enzyme active soya flour is widely used as a bread additive, at a level of about 0.7% of flour weight. Among other advantages claimed for its use, it has beneficial oxidizing agent on flour and extends the shelf life of the dough/bread (Yadav *et al.,* 2003).

METHODS

Source of Materials

The soybean seeds were purchased from Sabo Market in Ogbomoso, Oyo state, Nigeria.

Soybean Full fat Flour

The soybean seeds were soaked in the sample solutions (water, sodium carbonate, sodium bicarbonate and sodium chloride) respectively at room temperature. The seeds were subsequently washed with water and steam blanched at 100ºC and dehulled manually. The dehulled seeds were dried in a cabinet drier and milled. Full fat soybean flour was stored in sealed polythene bags with thickness of 85µ. The bags were stored at room temperature (28±2ºC) and relative humidity of 80%.

Storage

The samples were stored in airtight containers at room temperature for a period of three months. Samples were drawn from each of the stored samples for analysis at intervals of four weeks.

Analytical Methods

Moisture content, protein content (Micro-Kjedahl, Nx6.25), fat, ash and crude fiber were determined by the AOAC (1990) and Fasakin and Unokiwedi (1992) methods.

Statistical Analysis

The data collected from the studies were subjected to analysis of variance (Snedector and Cochran, 1968). The means were compared using the Least Significant Difference (LSD) Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSIONS

The protein content decreased from 33.25% at the zero week to 30.50% at the twelfth week which could be due to the action of ketogenic amino acids which were broken down to glucose thereby increasing the carbohydrate content of the sample (Table 1). The fat content reduced from 20.0% to 17.0% over the storage period. There was no significant difference in the protein content, ash content, fibre content, fat content and carbohydrate content at 95% confidence limit over the period of storage of 12 weeks. The ash content (2.0%) was constant throughout the storage period (Table 2) while moisture content increased from 8.0% to 12.0%. This may be due to the inefficiency of the storage method used in the study. Minimal changes occured in the crude fibre and protein contents throughout the storage period, this can be linked to the process of deamination leading to the breakdown of amino acids. However, some sources of nitrogen in the amino form must be available. The amino group from other amino acids enters the nitrogen pool and can be used for the synthesis of any amino acid whose carbon skeleton can be made. There was a decrease in the fat content while the free fatty acid values increased due to the action of peroxidase on the fat present in the sample.

Table 3 showed that the sample maintained a high protein content. The low carbohydrate and high protein content indicates that the rate of conversion of protein to carbohydrate during processing and storage was reduced due to the inactivation of enzymes by heat treatment.The ash content remained constant hence, there was no loss of minerals over the storage period. The low free fatty acid content at the zero week was due to the effect of steam blanching on lipase and lipoxidase, thereby reducing the rate of rancidity of the full fat flour.

The degree of oxidation in a fat or oil can be expressed in terms of peroxide value. When the double bonds of unsaturated fats become oxidized, peroxides are among the oxidation products formed. Oxidative rancidity results from the liberation of odorous products during breakdown of unsaturated fatty acids. This is the type of fat deterioration that can often be prevented or minimized by the addition of chemical antioxidants such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT). The free fatty acids, especially if they are of short-chain length, cause off-odors and rancid flavours in fats and oils. Hydrolytic rancidity does not require oxygen to occur but is favoured by the presence of moisture, high temperature and natural lipolytic enzymes (Potter and Hotchkiss, 1995).

From Table 4, it can be deduced that there were minimal changes in the protein, crude fibre and fat content. The low carbohydrate content of the sample may be due to the reduced action of ketogenic amino acids converted to carbohydrate (glucose) during the storage period. Fats are degraded by the process of hydrolysis which in the

Table 1 Results of shelf-life study of sample A

Analysis	Zero week	4th Week	8th week	12th week
Moisture %	6.00 ± 0.0	6.00 ± 0.1	14.00 ± 0.1	14.00 ± 0.1
Ash %	3.00 ± 0.0	2.00 ± 0.0	2.00 ± 0.0	1.00 ± 0.1
Protein %	33.25 ± 0.0	32.38 ± 0.0	32.38 ± 0.0	30.50 ± 0.2
Crude fibre %	5.00 ± 0.1	4.00 ± 0.0	3.00 ± 0.0	2.00 ± 0.1
Fat %	20.00 ± 0.0	19.00 ± 0.1	18.00 ± 0.0	17.0 ± 0.14
Free-fatty acid %	0.40 ± 0.1	0.30 ± 0.1	0.17 ± 0.0	0.11 ± 0.1
Carbohydrate %	32.75 ± 0.0	36.62 ± 0.0	30.62 ± 0.2	35.50 ± 0.1

± standard deviation of three replicates

Table 2 Results of shelf-life study of sample B

Analysis	Zero week	4th Week	8th week	12th week
Moisture %	4.00 ± 0.2	8.00 ± 0.2	8.00 ± 0.0	12.00 ± 0.3
Ash %	2.00 ± 0.0	2.00 ± 0.0	2.00 ± 0.0	2.00 ± 0.0
Protein %	35.00 ± 0.0	35.00 ± 0.0	34.58 ± 0.1	34.57 ± 0.1
Crude fibre %	6.00 ± 0.0	6.00 ± 0.0	5.00 ± 0.1	5.00 ± 0.0
Fat %	30.00 ± 0.0	28.00 ± 0.0	24.00 ± 0.0	22.0 ± 0.00
Free-fatty acid %	0.13 ± 0.0	0.12 ± 0.0	0.11 ± 0.0	0.10 ± 0.0
Carbohydrate %	23.00	21.00	26.42	24.43

± standard deviation of three replicates.

Table 3 Results of shelf-life study of sample C

Analysis	Zero week	4th Week	8th week	12th week
Moisture %	4.00 ± 0.1	6.00 ± 0.2	8.00 ± 0.1	8.00 ± 0.1
Ash %	2.00 ± 0.0	2.00 ± 0.1	2.00 ± 0.0	2.00 ± 0.2
Protein %	35.44 ± 0.6	34.13 ± 0.0	35.88 ± 0.0	35.00 ± 0.1
Crude fibre %	7.00 ± 0.1	8.00 ± 0.0	7.00 ± 0.0	6.00 ± 0.0
Fat %	29.00 ± 0.1	29.00 ± 0.1	30.00 ± 0.0	30.00 ± 0.0
Free-fatty acid %	0.40 ± 0.0	0.38 ± 0.0	0.27 ± 0.1	0.21 ± 0.1
Carbohydrate %	22.56	20.87	17.12	19.00

± standard deviation of three replicates

Table 4 Results of shelf-life study of sample D

Analysis	Zero week	4th Week	8th week	12th week
Moisture %	8.00 ± 0.1	10.00 ± 0.2	6.00 ± 0.2	6.00 ± 0.1
Ash %	3.00 ± 0.1	4.00 ± 0.0	3.00 ± 0.1	3.00 ± 0.0
Protein %	34.57 ± 0.6	35.00 ± 0.0	34.13 ± 0.0	34.00 ± 0.1
Crude fibre %	11.00 ± 0.1	10.00 ± 0.0	12.00 ± 0.0	11.50 ± 0.4
Fat %	26.00 ± 0.0	28.00 ± 0.0	29.00 ± 0.1	29.00 ± 0.1
Free-fatty acid %	0.11 ± 0.1	0.11 ± 0.1	0.14 ± 0.0	0.06 ± 0.0
Carbohydrate %	17.43	13.00	15.87	16.50

± standard deviation of three replicates

Key
Sample A - Soybean seeds soaked in ordinary water.

Sample B - Soybean seeds soaked in 0.5% w/v sodium bicarbonate solution.

Sample C - Soybean seeds soaked in 0.5% w/v sodium carbonate solution.

Sample D - Soybean seeds soaked in 0.5% w/v sodium chloride solution.

presence of moisture splits triglycerides into their basic components of glycerol and free fatty acids. There was significant difference in the moisture content and the free fatty acid content of the sample over the twelve week storage time.

CONCLUSION

Soybean seeds are generally known for their high fatty content. The soybean flour was stored in a cool, dry place and away from light to prevent lipid oxidation from occurring in the flour. The flour was also stored in an air and moisture proof sealed cellophane to prevent moisture gain. Soaking the seeds in chemical solutions before processing helped reduce the action of peroxidase on the samples which was evident in the low free fatty acid content of the samples towards the end of the shelf life period.

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