Effects of processing methods on the antinutritional factor and the nutritional composition of sesame (Sesamum indicum L) seed.

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Abstract

The effect of processing on phytic acid (PA) reduction and nutritional composition of sesame seed was investigated. Raw sesame seed (RASS) was compared with seeds processed by three different methods: roasted (ROSS), boiled (BOSS) and soaked (SOSS) sesame seeds. Processing had no significant (P>0.05) effects on the proximate composition and the amino acid profile of the seeds but, significantly (P<0.05) reduced the PA content of the seed. The soaked seed contained significantly (P<0.05) less PA compared to the raw (control) and the roasted seeds. Phytic acid reduction was similar in soaked and boiled seeds as well as boiled and roasted seeds.

It was concluded that soaking is an effective method of improving the nutritional quality of sesame seed.

Key words: Sesame seed, processing, anti-nutritional factor, nutritional quality

Introduction

Sesame (*Sesamum indicum* L) is a drought- tolerant crop adapted to many soil types (Ram *et al*., 1990). In Nigeria, there are about 335,000 hectares of land under sesame cultivation with yields between 1.5-2.0 tones/hectare (Ahmed, 2005). Sesame seed is an important source of edible oil and contains 50-60% oil compared to 20% in soyabean (Brar and Ahuja, 1979; Kato *et al*., 1998; Ahmed, 2005). The seed contains 22% crude protein and after oil extraction the protein content of the meal is about 46% (Peace Corps, 1990; Mamputu and Buhr, 1991). The amino acid composition of sesame seed is similar to that of soyabean with the exception of lower lysine (Mamputu and Buhr, 1991) and higher methionine (Olomu, 1995; Dipasa, 2003) in sesame seed. According to Olomu (1995) using sesame seed in the right proportions together with soyabean meal results in a balanced diet with respect to lysine and methionine. Sesame seed has been included in rations for poultry and swine (Gohl, 1981).

The main factor which limits the use of sesame seed as the main source of protein in monogastric diets has been its high phytic acid (PA) content (Mulky *et al*., 1989), an anti-nutrient which reduces the biological availability of zinc, calcium, magnesium and iron (Reddy *et al*., 1982; Mulky *et al*., 1989). Different processing methods have been reported to reduce the PA concentration of oil seeds. Cooking and fermentation significantly reduced the PA and phytate phosphorus of oil bean seeds (Mbajunwa, 1995). According to Mukhopadhyay and Ray (1999), the PA from raw sesame seed could be reduced below detection limit by fermentation with lactic acid bacteria (*Lactobacillus acidophilus*). This study was conducted to determine the effects of different processing methods on the PA content and the nutritional composition of sesame seed.

Materials and Methods

Source and Processing of Sesame Seed

Sesame seed (white variety) was purchased from a local market, screened and winnowed to remove sand, chaff and other foreign particles. A sample of the raw seed was taken and labeled RASS.

The cleaned seed was then processed using the following methods:

i) Roasted sesame seed (ROSS): The seed was roasted in a heated aluminum pot at $80^{o}C$ for 30 minutes, left to cool and labeled ROSS;
ii) Boiled sesame seed (BOSS): The seed was boiled in tap water at 100^{o} C for 30 minutes, sun-dried for 72 hours and labeled ROSS;
iii) Soaked sesame seed (SOSS): The seed was soaked in tap water for 24 hours, sun-dried for 72 hours and labeled SOSS.

A sample of sesame seed from each of the processing methods was ground to pass through a 40-mesh sieve and used for chemical analysis.

Chemical and Statistical Analyses

Chemical analysis was conducted at the zoology laboratory, University of Jos, Nigeria. Samples from the control and the three processing methods were analyzed in triplicate for proximate composition, amino acid profile and phytic acid content. Crude protein (N × 6.25) was determined according to the Kjedahl method (AOAC, 1990). Dry matter, crude fibre, ether extract and total ash were also determined according to the AOAC (1990). The soluble carbohydrate (NFE) was obtained by difference and the metabolizable energy (ME) calculated according to Ichaponani (1980)

The amino acid composition of the samples was determined using methods described by Spackman *et al*. (1958) and the phytic acid (PA) content determined the methods of McCance and Widdowson (1935) as modified by Stewart (1974).

Data were analyzed for variance (Steel and Torrie, 1980) and significant differences separated using the Duncan's Multiple Range test (Duncan, 1955).

Results

From the results (Tables 1 and 2) there were no significant (P> 0.05) effects of processing on the proximate composition and the amino acid profile of the seed, but processing significantly (P<0.05) affected its phytic acid (PA) content. The soaked seed contained less (P<0.05) PA compared to the roasted and raw seeds, but there were no significant (P>0.05) differences in PA content between the soaked and boiled seeds as well as the boiled and roasted seeds.

Table 1: Proximate composition of differently processed sesame seed meal

	Processing methods				
Nutrients (%)	RASS	ROSS	BOSS	SOSS	SEM
Dry matter (DM)	93.23	93.48	93.14	93.10	0.09 NS
Crude protein (CP)	26.14	25.78	25.81	26.21	0.11 NS
Ether extract (EE)	57.58	57.90	57.79	57.49	0.09 NS
Crude fibre (CF)	7.03	7.02	7.04	7.07	0.02 NS
Total ash	6.63	6.60	6.71	6.66	0.02 NS
Nitrogen free extract (NFE)	2.62	2.70	2.65	2.54	0.02 NS
* ME (Kcal ME/kg)	4,850.57	4,862.85	4,860.96	4,861.39	2.82 NS

RASS= Raw sesame seed, ROSS= Roasted sesame seed, BOSS= Boiled and dried sesame seed, SDSS= Soaked and dried sesame seed, *Metabolizable energy calculated according to the formula of Ichaponani (1980):ME (KCal/Kg) = 432+27.91 (CP+NFE+2.25xEE), SEM= Standard error of the mean, NS= Not significant (P> 0.05).

Table 2: Amino acid composition and phytic acid content of differently processed sesame seed meal

	Processing methods				
Amino acid (%)	RASS	ROSS	BOSS	SOSS	SEM
Lysine	1.36	1.36	1.34	1.40	0.01 ^{NS}
Histidine	1.25	1.24	1.26	1.28	0.01 ^{NS}
Arginine	5.60	5.52	5.56	6.02	0.01 ^{NS}
Asparticacid	5.55	5.50	5.52	5.57	0.02 ^{NS}
Threonine	1.95	1.90	1.92	1.99	0.02 ^{NS}
Serine	3.11	3.10	3.09	3.12	0.01 ^{NS}
Glutamic acid	9.00	8.58	8.50	9.06	0.14 ^{NS}
Proline	3.60	3.61	3.57	3.64	0.01 ^{NS}
Glycine	5.05	5.00	4.98	5.11	0.02 ^{NS}
Alanine	2.70	2.65	2.67	2.72	0.01 ^{NS}
Cystine	1.02	0.75	0.80	1.03	0.07 ^{NS}
Valine	2.85	2.86	2.80	2.88	0.02 ^{NS}
Methionine	1.60	1.58	1.59	1.63	0.01 ^{NS}
Isoleucine	2.28	2.23	2.24	2.26	0.01 ^{NS}
Leucine	3.60	3.60	3.58	3.62	0.01 ^{NS}
Tyrosine	2.20	2.16	2.19	2.18	0.01 ^{NS}
Phenylalanine	2.48	2.46	2.49	2.50	0.01 ^{NS}
Phytic Acid (μg/g)	42.50 ^{a}	31.00 ^{ab}	25.50 ^{bc}	9.98 ^{c}	4.81*

RASS= Raw sesame seed, ROSS= Roasted sesame seed, BOSS = Boiled and dried sesame seed, SOSS = Soaked and dried sesame seed, SEM=Standard error of the mean, NS = Not significant (P> 0.05), * = Significant (P< 0.05), a b c= means within the row with different superscripts differ significantly (P<0.05).

Discussion

The protein content of the seed used in this experiment was higher than the 22% reported in literature (Peace Corps, 1990; Mamputu and Buhr, 1991). Similarly, the values obtained for all the amino acid analyzed were superior to those reported elsewhere for sesame seed (Mulky *et al*., 1989; Olomu, 1995). These differences were attributed to varietal differences as reported by Oplinger *et al*. (1997) and possibly the extent of cleaning. Sesame seed is usually associated with too much sand and if not thoroughly cleaned the concentration of other nutrients (on dry matter basis) will be reduced and that fibre increased. The oil content of the experimental seed fell within the range (50-60%) reported by Brar and Ahuja (1979) and Sirato-Yasumoto *et al*. (2001). The crude fibre compared with the 6.30% (Aduku, 1992; Olomu, 1995). The seed used in this experiment contained less PA than the 50µ/g reported by Mulky *et al*. (1989). As mentioned earlier, varietal differences may be responsible for the lower PA in the experimental seed.

The significant reduction of PA by soaking corroborates the observations of Ologhobo and Fetuga (1984), Khokhar and Chauhan (1986), Duhan *et al*. (1989) and Teresa *et al*. (1999) that soaking is an effective method of reducing the PA content of legume seeds. The reduction of PA during soaking and boiling in this experiment is attributed to the solubility of this substance in water (Lolas and Markakis, 1975), a process which is further enhanced by the altered permeability of the seed coat by processing water (Duhan *et al*., 1989). Maga (1982) reported that heat does not readily destroy phytic acid. This further indicates that the reduction of PA in the boiled seed (moist heat) is due its solubility in the boiling water than the effect of heat.

From the results it was concluded that soaking in water will effectively reduce the antinutritive (PA) content of sesame seed without adversely affecting its nutritional composition.

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