EFFECT OF SOAKING IN DIFFERENT SOLUTIONS ON THE ANTINUTRITIONAL FACTORS OF SOYBEAN

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Abstract

Soaking soybean seeds (Glycne Max. L Essex variety) in different solutions such as deionized water, acetic acid (from 0.03-0.6N), sodium bicarbonate and sodium hydroxide (0.01-0.1 N) for 6,12 and 24 hr., reduced the antinutritional factors. Soaking soybean seeds in deionized water, acetic acid, Sodium bicarbonate and Sodium hydroxide for 24hr. reduced trypsin inhibitor activities by (57.0, 53.0, 70.6, 100%), phytic acid (32.69, 42.31, 36.54, 42.31%), lipoxygenase (33.41, 84.80, 85.40, 96.0%), respectively.

INTRODUCTION

The diet of many millions of people in various parts of the world is deficient in protein and calories. Presence of antinutritional factors is one of the main drawbacks limiting the nutritional and food qualities of the legumes (Liener, 1976). Phytate, widely distributed in food grains (Deboland *et al.*, 1975) lowers the bioavailability of minerals (Davies and Nightingale, 1975; Erdman, 1979) and inhibits several proteolytic enzymes and amylases (Singh and Krikorian 1982; Deshpande and cheryan, 1984).

All Legumes, have been found to contain trypsin inhibitors in varying amounts (Liener, 1976). Trypsin inhibitors when ingested by man in significant amounts disrupt the digestive process and may lead to undesirable physiological reactions (Booth

et al., 1960). For effective utilisation of soybeans for human nutrition removal / elimination of antinutritional factors is one of the main drawbacks limiting the nutriional and food qualities of the legumes (Liener, 1976). Phytate, widely distributed in food grains (Deboland *et al.*, 1975) lowers the bioavilability of minerals (Davies and Nightingale, 1975; Erdman, 1979) and inhibits several proteolytic enzymes and amylases (Singh and Krikorian 1982; Deshpande and cheryan, 1984).

Foreign material such as stems, pods, sticks and stones must be removed. Crushed beans and splits should be removed if possible . Of much greater importance is the use of mold-free soybeans. Moldy beans have little, if any, value for any purpose and may contain toxins.

The aim of this investigation was to study the effect of soaking soybean seeds in different solutions such as deionized water, acetic acid, sodium bicarbonate and sodium hydroxide. The effects of these treatments on trypsin inhibitor, phytic acid and lipoxygenase were studied.

MATERIALS AND METHODS

Soybean seeds (Glycine Max. L variety Essex) were obtained from the Agricultural Research Station, Petersburg, Virginia, USA.

Moisture content

Moisture was determined according to the methods described in A.O.A.C (1975) .

Determination of trypsin inhibitor

Trypsin inhibitor activity was determined by the method of Kakade *et al.*, (1969).

Determination of phytic acid

Phytate was extracted and determined according to the procedure described by Camire and Clydesdale (1982) and modified by Mohamed *et al.*, (1986).

Soaking of soybean seeds

Soybean seeds were soaked (10 gm/ 250 ml) in deionized water, acetic acid (0.03 N, 0.06 N, 0.6 N), Sodium bicarbonate (0.01 N, 0.05 N, 0.10 N) and Sodium hydroxide (0.01 N, 0.05 N, 0.10 N) for 6, 12 and 24hr., washed and dried in freeze dryier. Soybean meal were deffated using hexane 5 gm/50 ml and homoginized for 3 min. three times.

Determination of lipoxygenase

Lipoxygenase was determiened according to Engesth *et al.*, (1987) lipoxygenase activity was measured on crude extracts of soaked soybeans.

RESULTS AND DISCUSSION

Table (1) shows that soaking soybean seeds in different solutions reduce the activity of typsin inhibitor (TI) by about 5.8, 41.2 and 57.25% when soaked in deionized water compared to control. When the seeds soaked in acetic acid for 6hr a slight decrease and increase in TI activity was found due to the normality, while a remarkable reduction was found due to prolonged soaking (12 and 24 hr.), respectively. For example, soaking in acetic acid for 12 hr. resulted in reduction due to acid normality while after 24 hr the reduction was 48.9, 56.5 and 52.77%, for 0.03, 0.06 and 0.60 Nactic acid respectively. When sodium bicarbonate at 0.01, 0.05 and 0.1 N were used for soaking, a slight increase in TI activity at 0.01 N (361.44 units) then decreased gradually according to alkali concentration after 6 hr. of soaking being 214.34 and 188.85 units. A remarkable decrease was observed after 12 and 24 hr of soaking compard to control. Soaking in sodium hydroxide at 0.01, 0.05 and 0.1 N resulted in decreasing TI activity by about 30, 40 and 67.61; 39.67, 49.15 and 67.60; 40.51, 55.33 and 100% respectively, after 6,12 and 24 hr. of soaking. From the above mentioned data, it could be concluded that soaking in alkali reduced more trypsin inhibitor than acetic medium and water. In this respect, Kakade, *et al.*, (1974) reported that trypsin inhibitor is very stable in acidic condition. On the contrary, Cheman, *et al.*, (1991) found that soaking dry soy beans in dilute HCl reduced the activities of lipoxygenase and trypsin inhibitor. This decrease may be due to enzyme inactivition as a result of prolonged exposure to water. Also Collins and Sander (1976) and Che Man, *et al.*, (1991) mentioned that the decrease in TI with increasing soaking time was attributed mainly to leaching of the protease from the intact cotyledones into the soaking medium.

Table 1. Trypsin inhibitor in defatted soybean meal (Calculated on dry weight basis).

Soaking treatment	Conc.	TI units/mg soybean*			
		0 hr	6 hr	12 hr	24 hr
Control		33.78	---	---	---
Deionized water			311.74	141.42	194.48
	0.03 N		320.66	168.89	187.76
actic acid	0.06 N		340.68	143.84	155.32
	0.60 N		365.79	168.00	156.24
Sodium bicarbonate	0.01 N		361.44	175.91	172.60
	0.05 N		214.34	168.64	164.59
	0.10 N		188.85	189.24	97.73
Sodium hydroxide	0.01 N		196.75	185.56	107.14
	0.05 N		199.54	147.74	0.00
	0.10 N		231.51	168.18	105.67

* means of three readings

Table (2) shows that soaking soybean in deionized water, acetic acid and Sodium bicarbonate resulted in a slight decrease in phytic acid content after 6 hr., where as gradually decrease in phytic acid content by about (9.6, 26.92 and 40.38%) when soybean seeds soaked for 6 hr. in (0.01 N, 0.05 and 0.1 N) soudium hydroxide respectively. After 24 hr. of soaking it was observed decrease in phytic acid content in all treatments and the most effectives treatments were acetic acid 0.03 N (42.31) and sodium hydroxide 0.05 N and 0.1 N (40.38 and 42.31%) respectively, followed by sodium bicarbonate 0.10 N, (36.54%) and Deionized water 32.69%. It could be concluded that sodium hydroxide at normality (0.05 N and 0.10 N) reduce phytic acid content after 6 hr. of soaking (26.92% and 40.38%) while it needs 24 hr. soaking in acetic acid (0.03 N) to reach nearly the same decreasing in phytic acid, that means soaking in alkali reduces the time to leaching out about 40% of phytic acid and this may be due to that alkali softens the cell wall gets rid of undesirable matter such as phytic acid.

These treatments are very important because phytic acid lowers the bioavailability of minerals (Davis and Nightinogle, 1975), inhibits the digestability of protein (Singh and Krikorian, 1982), and carbohydrates (Deshpande and Cheryan, 1984) and leads to hard cook in pulses (Boulter, 1982). The last undesirable attribute increases cooking time of legume seeds and concerns people in developing countries

where energy sources including fuel wood are becoming increasingly scarce and expensive.

Table 2. Phytic acid in deffated soybean meal.

Soaking	Conc.	gm phytate/100 gm defatted soybean meal*			
		0 hr	6 hr	12 hr	24 hr
Control	---	1.04	---	---	---
	---		1.00	0.90	0.70
Actic acid	0.03 N		0.83	0.69	0.60
	0.06 N		1.04	1.03	1.02
	0.60 N		0.95	0.94	0.94
Sodium bicarbonate	0.01 N		1.04	0.99	0.94
	0.05 N		1.02	0.84	0.77
	0.10 N		1.02	0.70	0.66
Sodium hydroxide	0.01 N		0.94	0.94	0.90
	0.05 N		0.76	0.70	0.62
	0.10 N		0.62	0.60	0.60

* means of three readings

Table (3) shows that soaking of soybeans in different solutions reduced the activity of lipoxygenase and the maximum reduction were when soybeans soaked in sodium hydroxide 0.10 N (96.0%), Sodium bicarbonate 0.01 N (85.4%) and acetic 0.60N (84.8%) after 24 hr. soaking. Considerable evidence has accumulated in the literature implicating lipoxygenase-mediated conversion of lipohydroperoxides and their subsequent degradation to form volatile and nonvolatile constituents responsible for off-flavors.

(Wolf, 1975; Sessa and Rackis, 1977; Sessa, 1979; Moll *et al.*, 1979; Macleod and Ames, 1988).

Table 3. Lipoxygenase activity in defatted soybean meal (calculated on dry weight basis).

Soaking	Conc.	Lipoxygenase units/mg defatted soybean meal			
		0 hr	6 hr	12 hr	24 hr
Control	---	692.5	---	---	---
Deionized water	---		584.3	538.3	461.3
Actic acid	0.03 N		462.3	414.9	143.6
	0.06 N		625.7	516.3	388.7
	0.60 N		487.0	355.6	105.3
Sodium bicarbonate	0.01 N		570.7	213.7	101.1
	0.05 N		681.3	534.3	459.9
	0.10 N		626.4	502.0	193.0
Sodium hydroxide	0.01 N		685.6	498.9	481.4
	0.05 N		601.3	219.7	21.15
	0.10 N		517.5	181.0	166.9

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تأثير النقع فى محاليل مختلفة العيارية على القيمة الحيوية والمثيطات فى فول الصويا

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تم نقع بذور فول الصويا صنف اسكس فى الماء منزوع الايونات ومحاليل العيارية من (حمض الخليك – بيكربونات الصوديوم – الصودا الكاوية) لمدة ٦ ، ١٢ ، ٢٤ ساعة.

وقد تم دراسة تأثير ذلك عن مثبط انزيم التربسين ، حمض الفيتك وانزيم الليبوكسجينيز وقد وجد ان نقع البذور لمدة ٢٤ ساعة فى الماء منزوع الايونات ، حمض الخليك ، بيكربونات الصوديوم ، الصودا الكاوية له تأثير فعال على المثبطات حيث كل نشاط مثبط انزيم التربسين بنسب (٥٧,٠ ، ٥٣,٠ ، ٧٠,٦ ، ١٠٠٪) والفيتيك بنسب (٣٢,٦٩ ، ٤٢,٣١ ، ٣٦,٥٤ ، ٤٢,٣١ ٪) وانزيم الليبوكسجينيز بنسب (٣٣,٤١ ، ٨٤,٤٠ ، ٨٥,٤٠ ، ٩٦٪) على التوالى .