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The Effect of Soaking and Cooking on the Oligosaccharide Content of Seker a Dry Bean Variety (*P. vulgaris, L*) Grown in Turkey

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Abstract: In this research, the effects of cooking alone, soaking-cooking combination on the oligosaccharide contents of a registered dry bean variety, Seker grown in Turkey was studied. Saccharose, raffinose and stachyose contents of the raw material were 3.91, 1.86 and 3.84%, respectively. The highest removing, to the extent of decrease up to, approximately, 70% was achieved by soaking in 0.5 % sodium bicarbonate solution for 18 hour followed by cooking in pressured kettle. These conditions could be recommended to remove undesirable sugar contents of the Seker bean used for culinary purposes.

Keywords: Dry beans, oligosaccharides, flatulence, soaking, cooking

Introduction

Legumes, especially beans are considered important and inexpensive protein and dietary fiber sources in human nutrition. Further, beans contain a considerable amount of vitamins and minerals (Vidal-Valverde *et al*., 1993). All legumes, however, contain several oligosaccharides, among which raffinose, stachyose and verbascose are of importance (Naczk *et al*., 1992; Abdel-Gawad, 1993; Trugo *et al*., 1993). These sugars are generally undesirable due to flatus factors. Because human alimentary tract is deprived of ∝-galactosidase capable of hydrolyzing the ∝- 1→6 galactoside linkage, therefore, these oligosaccharides are not digested and accumulate in large intestine where they are undergone anaerobic fermentation by bacteria. Thus, some gases are produced owing to fermentation, such as carbon dioxide, hydrogen and methane (Reddy *et al.,* 1980; Fleming, 1981; Alfred *et al*., 1982).

Traditional treatments such as soaking, cooking, germinating and fermenting have been used to improve nutritional quality of the legumes, the dry beans (Trugo *et al*., 1993; Barampama and Simard, 1994). It has been shown that, antinutritional and flatus factors are removed considerably by utilizing these processes. Although there are a number of research associated with oligosaccharides of dry beans, unfortunately, there is a little research about the oligosaccharides of the dry beans grown in Turkey and the removal procedures before the consumption. The aim of this research were to determine oligosaccharide contents of registered dry bean variety, Seker, grown in Turkey, and to see what extent of some treatments like soaking and cooking are effective in the removal of some oligosaccharides.

Materials and Methods

Dry bean variety Seker samples used as research material were supplied from East Anatolia Institute of Agricultural Research. The damaged beans were segregated from main population, and then raw bean material were mixed with distilled water at 1:3 (w/v) and soaked at room temperature (20±2 °C) for 12 or 18 hours. Alternatively, soaking was undertaken in the same conditions in which distilled water replaced by 0.5% sodium bicarbonate solution. After the draining the soaking water and washing, the beans were mixed with distilled water in 1:4 (w/v) ratio and cooked in boiling water (conventional cooking) for 60 minutes or in a pressured kettle (121 °C- 15 psi) for 30 minutes.

Chemical Analyses: Total solids, ash, protein contents and pH of the samples were determined according to AOAC (Anonymous, 1975), while the determination of starch amount was done according to (Anonymous, 1983).

Extraction and identification of oligosaccharides: Raw and soaked-cooked dry beans were subjected to oligosaccharide extraction with 100 ml (80%) ethanol according to Tanaka *et al.* (1975). The extracts and washings were combined and concentrated to 100 ml under vacuum at 50 °C. The oligosaccharides were separated and identified by thin-layer chromatography (Tanaka *et al*., 1975), while the sugars (raffinose and stachyose) were identified by comparison with the reference standards obtained from Nestec (S.A. Centre de Recherche, Sweden) and saccharose from Fluka (Fluka Chemie AG CH-9470 Buchs).

Quantitative analysis of oligosaccharides: Saccharose, raffinose and stachyose contents of the beans were quantitavely determined by using guide-strip technique. Sugar spots on chromatograms were scraped off and extracted with 2 ml of distilled water in a test tube overnight at room temperature (Tanaka *et al*., 1975). Then oligosaccharides were determined with thiobarbutiric acid reaction (Percheron, 1962) with the reference standards containing 10-100 µg/ml of each oligosaccharide.

Table 1: The results of chemical properties of raw Seker dry bean variety (%, dry bases)

Dry matter	Moisture	Protein	Starch	Ash	pH	Total oligosaccharide
90.39	9.61	20.11	38.21	4.11	6.45	5.69

Table 2: Mean Sugar Contents and SD values of Seker Bean Variety, (%, Dry Bases)

process	sugar									
	Sucrose				Raffinose			Stachyose		
	Mean	SD	Δ		Mean	SD	Δ	Mean	SD	Δ
A*	3.91 ±	0.06	-		1.86 ±	0.24	-	3.84 ±	0.69	-
B	3.37 ±	0.01	(%14)		1.52 ±	0.11	(%18)	3.12 ±	0.22	(%19)
C	2.88 ±	0.06	(%26)		1.16 ±	0.22	(%38)	1.55 ±	0.45	(%59)
D	3.04 ±	0.30	(%22)		1.08 ±	0.04	(%42)	2.74 ±	0.13	(%29)
E	2.73 ±	0.06	(%30)		0.69 ±	0.06	(%63)	1.93 ±	0.01	(%50)
F	2.90 ±	0.02	(%26)		0.94 ±	0.03	(%50)	1.87 ±	0.08	(%51)
G	2.59 ±	0.11	(%34)		0.63 ±	0.03	(%66)	1.85 ±	0.08	(%52)
H	2.86 ±	0.09	(%27)		0.86 ±	0.01	(%54)	1.62 ±	0.69	(%58)
I	2.27 ±	0.40	(%42)		0.79 ±	0.35	(%58)	1.87 ±	0.05	(%52)
J	2.07 ±	0.20	(%47)		0.74 ±	0.04	(%60)	1,16 ±	0.06	(%70)
K	1.38 ±	0.21	(%65)		0.53 ±	0.10	(%72)	1.15 ±	0.28	(%71)

SD: standard deviation, Δ: decrease in percentages

A*= raw; B= cooked in boiling water (60 min); C= pressured cooking (121 °C, 15psi) for 30 min; D= soaked in distilled water 12 hr and cooked in boiling water (60 min); E= soaked in distilled water 18 hr and cooked in boiling water (60 min); F= soaked in 0.5% $NaHCO_3$ solution 12 hr and cooked in boiling water (60 min); G= soaked in 0.5% $NaHCO_3$ solution 18 hr and cooked in boiling water (60 min); H= soaked in distilled water 12 hr and pressured cooking (121 °C, 15psi) for 30 min; I= soaked in distilled water 18 hr and pressured cooking (121 °C, 15psi) for 30 min; J= soaked in 0.5% $NaHCO_3$ solution 12 hr and pressured cooking (121 °C, 15psi) for 30 min; K= soaked in 0.5% $NaHCO_3$ solution 18 hr and pressured cooking (121 °C, 15psi) for 30 min

The research was conducted in two replications, and statistical significance of means was evaluated by analysis of variance (Yildiz and Bircan, 1991).

Results and Discussion

The results of the chemical analyses of the raw Seker dry bean variety were presented in Table 1.

As seen in Table 1, moisture and protein contents of the bean were 9.61 and 20.11% respectively, but these values were reported as 8.52 and 16.36% for the same bean (Guvenc and Gungor, 1996). The differences seen in this variety are usually due to the several factors such as ecological aspects; soil quality, cultivation techniques, maturity levels, transportation and storage conditions (Cemeroglu and Acar, 1986).

The processes applied in this research on the Seker dry bean variety and the changes occurred in saccharose and oligosaccharide contents were shown in Table 2.

As could be noticed in Table 2, cooking the samples after soaking in sodium bicarbonate solution causes more decrease in the sugar contents than that of the samples soaked in distilled water. Similar results were also reported that legumes soaked in alkali medium gave lower sugar content compared to other soaking conditions (Abdel-Gawad, 1993). Also, Ku *et al.* (1976) noted that soaking in the 0.5% sodium bicarbonate solution might increase softening of the testa and cotyledons that could increase the sugars extraction.

In this research, pressured cooking was significantly ($p<0.01$) more effective on the sugar degradation than that of the conventional cooking. The decrease in stachyose content was high in the pressure-cooking samples that were not soaked (Table 2). However, it was reported that sucrose and oligosaccharides contents of the legumes with pressured cooking were lower than that of the normal cooking conditions (Jood *et al.*, 1985). It was speculated that the cotyledon is lightly damaged with pressured cooking and may absorb more water (Reddy and Salunkhe, 1980).

In this research, the variation of among the soaking times was significant ($p<0.01$), for example, when the soaking time increased, the sugar contents of the samples were decreased. Similar results were also reported by some other researchers (Kataria *et al.*, 1990).

As a result, pressure cooking after soaking in distilled and sodium bicarbonate solutions for 18 h decreased the following sugars; saccharose, raffinose and stachyose contents at 42-65, 58-72 and 52-71%, respectively. Although the beneficial effects of soaking in

sodium bicarbonate solution to decrease saccharose and oligosaccharide contents, alkali condition may cause further destruction in the Vitamin B contents, especially thiamin and riboflavin (Swaminathan, 1974). Therefore, tap water might be a good alternative to protect vitamins and have a moderate decrease for the flatulence factors.

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