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Effect of processing on dietary fiber contents of selected legumes and cereals.

Azizah AH and Zainon H

Department of Food Science, Faculty of Food Science and Biotechnology, Universiti Pertanian Malaysia 43400, UPM, Serdang, Selangor D.E.,

ABSTRACT

Effects of soaking, boiling and roasting on TDF (total dietary fiber), SDF (soluble dietary fiber) and IDF (insoluble dietary fiber) of legumes (mung bean, soya bean, ground nut) and cereals (rice, wheat, barley) were studied. Results indicated that thermal processing gave different effects on TDF, IDE and SDF when analyzed using enzymatic-gravimetric methods. The changes in IDE content may explain the observed changes in TDF since SDF of most samples remained the same. In samples with high protein both SDF and IDE increases with thermal treatments, and this could be attributed to the production of Maillard reaction products.

INTRODUCTION

Dietary fiber, defined as the sum of lignin and polysaccharides that are not digested by the endogenous secretions of the human digestive tracts (Trowel *et al.*, 1976), is an important component of food. Accumulating evidence favors the view that increased intake of dietary fiber in an otherwise low-fiber diet, can have beneficial effects in humans (Cummings *et al.*, 1976; Dukehart *et al*, 1989; Jenkin's *et al.*, 1977). Some claimed benefits of a high fiber diet are to prevent or alleviate maladies such as cardiovascular diseases, diabetes, diverticulosis and colon cancer.

In view of these, more raw fiber is being incorporated into food as food ingredients. However, thermal processing or household cooking may alter the composition of these fiber and thus alter their physiological effects' to human body (Weber and Chaudhary, 1987). Since some browning products may be analyzed as lignin, cooking that causes browning reactions can increase the apparent fiber content of the foods. Subjecting starchy foods to heat also may confer more ordered structures to starch molecules and render some of the starches indigestible. Since they are not digested, consequently, they would be classed under dietary fiber. The objective of this research was to determine the effects of processing on total dietary fiber (TDF), insoluble dietary fiber (IDF) and soluble dietary fiber (SDF) of selected cereals and legumes.

MATERIALS AND METHODS

Cereals (wheat, barley, rice) and legumes (soya beans, mung beans, ground nuts) were obtained from local supermarket in Selangor.

Sample preparation

All samples were blended in a commercial blender for 10 minutes. Samples with fat content >10% (soya beans and ground nut) were first defatted using Soxhlet procedure before proceeding to each treatments. The treatments were soaking (20g) in distilled water (200 ml) for 8hr at RT, boiling (20g) in distilled water (200 ml) for 15 mm and roasting (26g) for 5 min at 180ºC. The treated samples were then weighed, freeze dried and kept in vacuumed desiccator until analysed.

Determination of total dietary fiber, soluble dietary fiber and insoluble dietary fiber

The procedure used for the determination of TDF, IDE and SDE, is a slight modification of enzymatic-gravimetric method of Prosky *et al.* (1988)

Statistical analysis

Samples were analyzed in duplicates and significance differences between control and treated samples were determined at the 5% level using Duncan test. These analyses were performed with SAS program (1985).

RESULTS AND DISCUSSION

Total Dietary Fiber

Total dietary fiber (TDF) of various legumes and cereals before and after processing is given in Table 1. The three legumes studied, ground nut, mung bean, soya bean contained higher TDF 25.9%, 25.3%, 22.3% respectively than the three cereals, rice, wheat, barley 1.1%, 14.2%, 15.8%, respectively. Soaking was found to have no effect in most samples. Similar observations were reported by Vidal-Valverde *et al.* (1992) when lentils were soaked for 9 hours at room temperature. Boiling at 100ºC for ten minutes, on the other hand, caused a significant ($p<0.05$) reduction of TDE in barley but increase in that of rice.

Roasting at 80ºC for 5 minutes significantly ($p<0.05$) increased TDE of wheat, rice, mung bean and soya bean but decreased significantly ($p<0.05$) TDF of ground nut. The results indicated that different treatments resulted in different effects of TDF when analyzed using enzymatic-gravimetric methods.

Insoluble Dietary Fiber

Table 2 showed the effects of treatments on TDF of selected legumes and cereals. As in TDF, soaking does not have any effect on IDF of all samples except for wheat and mung beans, which were significantly ($p<0.05$) reduced. Comparing all boiled samples to controls, IDF of wheat, barley and mung beans were found to reduce significantly ($p<0.05$) while that of soya beans were increased significantly ($p<0.05$).

Roasting was found to reduce significantly ($p<0.05$) IDF of wheat, barley and mung bean. The reduction in IDF of cereals and legumes after heat treatments were also observed by other investigator (Chang & Morris, 1990; Vidal-Valverde & Frias, 1991). On the contrary, Thed and

Phillips (1995) noted an increase in IDF of boiled and microwaved potatoes. They attributed this phenomenon to the formation of lignin-like substances or to chemically modified indigestible starch (resistant starch). The different results may be due to the different temperatures used by Thed and Phillips (1995).

Table 1: Total dietary fiber (%)* in samples undergone various treatments.

Sample	Control (mean ± SD)	Soaked (mean ± SD)	Boiled (mean ± SD)	Roasted (mean ± SD)
Wheat (tritium vulgare)	14.17a ±0.91	11.38a +1.38	14.94a ±1.26	16.89a ±1.52
Barley (hordeitm vulgare)	15.82a ±1.67	13.95a ±1.85	7.24a ±1.33	16.77a ±2.20
Rice (oryza saliva)	1.09a ±0.66	4.48b ±1.67	2.55b ±1.32	2.26b ±0.17
Groundnut (arachius hypogea)	25.90a ±1.54	23.84a ±1.71	24.32a ±1.39	18.29b ±0.66
Mung Bean (phaseolus aureus)	25.26ab ±1.29	20.33b ±1.23	26.87ab ±0.46	35.86c ±2.33
Soya Bean (glycine hispida)	22.32a ±1.25	23.74a ±1.25	23.31a ±2.00	27.13b ±0.66

$$\text{*\% Dietary Fiber (expressed as dry weights)} = \frac{100\ (\text{wt. residue - wt. protein - wt. ash - blank})}{\text{wt. Sample}}$$

Value with the same letter is not significantly (p<0.05) different.

It is interesting to note that both heat treatments appeared to increase significantly (p<0.05) IDF of soya beans. Due to the higher content of proteins in soya beans (34%) than other samples, it is possible that thermal processing may have caused production of Maillard reaction products and thus increase its IDF value. Similar results were reported by Chang and Morris (1990; Vidal-Valverde & Erias, 1991) when soya fiber was autoclaved and microwaved.

Soluble Dietary Fiber

Effects of various treatments on SDF can be seen in Table 3. SDF remained unchanged in all samples except in roasted soya beans that was found to increase significantly (p<0.05). This results agrees with findings of Varo *et al.* (1983) and Thed and Phillips (1995). The increase in SDF of roasted soya beans may be attributed to formation of Maillard reaction products. (Chang & Morris, 1990; Vidal-Valverde & Frias, 1991).

Table 2: Insoluble dietary fiber (%)* in samples undergone various treatments.

Sample	Control (mean ± SD)	Soaked (mean ± SD)	Boiled (mean ± SD)	Roasted (mean ± SD)
Wheat (tritium vulgare)	8.40a ±0.54	2.91b ±0.97	5.99c ±1.29	5.45c ±0.81
Barley (hordeitm vulgare)	9.51a ±0.93	5.76a ±0.55	4.77b ±0.79	4.87b ±0.27
Rice (oryza saliva)	0.700a ±0.57	1.97b ±0.87	1.71b ±0.63	1.38a ±0.15
Ground nut (arachius hypogea)	13.10ab ±0.84	10.08b ±1.18	15.93a ±1.26	12.37ab ±0.45
Mung Bean (phaseolus aureus)	23.29a ±1.77	12.25b ±1.17	18.08b ±0.23	14.50b ±0.96
Soya Bean (glycine hispida)	12.12a ±0.84	15.95a ±0.25	20.97b ±0.29	29.41b ±0.45

*% Dietary Fiber (expressed as dry weights) = $\frac{100 \text{ (wt. residue - wt. protein - wt. ash - blank)}}{\text{wt. Sample}}$

Value with the same letter is not significantly ($p<0.05$) different.

Table 3: Soluble dietary fiber (%)* in samples undergone various treatments.

Sample	Control (mean ± SD)	Soaked (mean ± SD)	Boiled (mean ± SD)	Roasted (mean ± SD)
Wheat (tritium vulgare)	2.98ab ±1.10	4.01a ±1.11	2.07ab ±0.84	0.45b ±0.46
Barley (hordeitm vulgare)	3.52a ±1.14	5.80a ±0.94	2.61a ±1.0	6.38a ±1.74
Rice (oryza saliva)	0.58a ±0.60	1.53a ±0.94	0.27a ±0.43	0.93a ±0.80
Ground nut (arachius hypogea)	3.98ab ±0.74	4.96b ±0.93	8.06b ±0.45	1.37a ±0.25
Mung Bean (phaseolus aureus)	1.69a ±0.66	2.21a ±0.57	3.57b ±0.82	7.82b ±0.93
Soya Bean (glycine hispida)	4.55ab ±1.57	5.90ab ±0.93	6.51b ±0.42	0.77a ±0.78

*% Dietary Fiber (expressed as dry weights) = $\frac{100 \text{ (wt. residue - wt. protein - wt. ash - blank)}}{\text{wt. Sample}}$

Value with the same letter is not significantly ($p<0.05$) different.

CONCLUSION

The results indicated that different processing treatments have different effects on the IDF, SDF and TDF of selected cereals and legumes. The changes in IDF content may explain the observed changes in TDF since SDF of most samples remained the same after various treatments. In samples with high protein content like soya beans, both IDF and SDF increases with thermal treatments that may be attributed to the production of Maillard reaction products. To further evaluate effects of processing, different treatments under various conditions should be studied. Data on dietary fiber are becoming crucial as public awareness of its importance increased and consequently its utilization as food ingredients increased to satisfy health-conscious consumers.

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