EVALUATION OF BOILED FENUGREEK SEEDS FOR CHEMICAL, NUTRITIONAL AND FUNCTIONAL PROPERTIES

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التقييم الكيماوى والتغذوى والخواص الوظيفية لبذور الحلبة المستعملة

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ملخص البحث

تم غليان بذور الحلبة لمدة ٢٠ دقيقة فى الماء ودرس تأثير ذلك على التركيب الكيماوى للبذور ومنحنى ذوبان البروتين على درجات حموضة مختلفة (١ ـ ١٠) كذلك تم دراسة تأثير الغليان على محتوى البذور من حمض الفيتيك والتانينات الكلية والقيمة الهضمية المعملية وكذلك الخواص الوظيفية للدقيق الناتج ومقارنة ذلك بالعينة الغير معاملة بالغليان وأوضحت نتائج هذه الدراسة مايلى :ـ

١ ـ انخفض محتوى السكريات الذائبة والرماد الكلى وكذلك الزيت فى البذور المعاملة بالغليان عن تلك الغير معاملة .
٢ ـ أيضا أدى الغليان الى انخفاض كبير فى محتوى البذور من الالبيومينات وكذلك الجلوبيولينات بمقارنته فى البذور الجافة والغير معاملة .
٣ ـ زاد محتوى البذور من النيتروجين الكلى وكذلك النيتروجين اللابروتينى بسبب المعاملة بالغليان عن تلك البذور الغير معاملة .
٤ ـ انخفض معدل ذوبان البروتين فى البذور المعاملة بالغليان عن تلك الغير معاملة وذلك على جميع درجات الحموضة المختلفة .
٥ ـ انخفض محتوى البذور من حمض الفيتيك وكذلك التانينات الكلية بسبب الغليان .
٦ ـ ارتفعت القيمة الهضمية المعملية لبروتينات البذور المعاملة بالغليان بدرجة واضحة عن تلك الغير معاملة وخاصة بواسطة انزيم التربسين بسبب التثبيط الحرارى لمضادات هذا الانزيم والتى توجد فى بذور الحلبة .

٧ ـ تحسنت الخواص الوظيفية مثل المقدرة على امتصاص الماء والزيت وأيضا خواص الرغوة من حيث سعتها ومدى ثباتها على درجة حرارة الغرفة لمدة ٦٠ دقيقة فى العينات المعاملة بالغليان عن تلك الغير معاملة ٠

٨ ـ أدى غليان بذور الحلبة الى انخفاض واضح فى السعة الاستحلابية عن تلك الغير معاملة ٠

ومن النتائج السابقة يمكن القول أن بذور الحلبة التى سبق غليانها يمكن أن تجد استخداماً فى عديد من الأغذية مثل منتجات المخابز والشوربات ذات القوام الكثيف وأغذية الأطفال كمصدر لبروتين ذات قيمة غذائية عالية ٠

ABSTRACT

Boiling of fenugreek seeds decreased the contents of soluble sugars, total ash albumin and globulin fractions, but increased total nitrogen and non-protein nitrogen apparently compared to original seeds. The protein solubility index also decreased after boiling due to heat denaturation of protein molecules. Phytic acid, total tannins were reduced and protein digestibility markedly increased by all enzymes used. Therefore, the nutritional quality of boiled seeds was much higher than that of original sample. Water and oil absorption capacities were improved after boiling the seeds also, foaming properties. Meanwhile, emulsification capacity was decreased due to boiling. Generally boiled fenugreek seeds could be used in many food products such as bakery products and viscus soups as a source for protein.

INTRODUCTION

Fenugreek seeds are very well known to most of the Egyptians. Sprouted seeds are quite popular, also the dry seeds extracts is used by alot of people as a cold and hot drink instead of tea. The remained seeds after boiling and extraction are considered as a waste and so far, used as animal feeding specially poultry. Although, there are several reports about the chemical composition of the dry and

germinated seeds (El-Mahdy and El-Sebaiy, 1982; El-Shimi and Damir, 1984 and Abd El-Aal and Rahma, 1986). However, there is no available informations about the effect of boiling process on the chemical and nutritional value of boiled seeds. Therefore, this work was carried out to evaluate the boiled fenugreek seeds and its possible utilization in foods.

MATERIALS AND METHODS

Materials:

Fenugreek seeds were obtained from the local market of Shebin El-Kom City. The seeds were cleaned by hand to remove the foreign matters before boiling.

Preparation of Boiled Seeds:

About 300 g of cleaned seeds were put in 2 L beaker with 900 ml. of distilled water. The contents were heated under direct flame. After 20 minutes from boiling the boiled seeds were taken for drying in oven at 50°C overnight. Both boiled and unboiled, dried seeds were ground to pass through a 70 mesh (British Standard Screen) sieve.

Analytical Methods:

Moisture, total nitrogen, non-protein nitrogen, ash, and ether extract contents were determined according to the AOAC, (1975) method. Soluble sugars were determined in the 80% ethanol extract by the method of Dubois et al. (1956) and expressed as glucose. Total tannins and phytic acid were estimated according to the methods of AOAC(1975), and Wheeler and Ferrel (1971) respectively. The results are expressed as mg per gram moisture free sample. Albumin and globulin contents were determined in water and 0.1 M NaCl respectively as described by Abd El-Aal et al. (1986).

Protein solubility index: This was determined at different pH values according to Rahma and Narasinga Rao (1979), using a flour solvent ratio of 1:40 (w/v).

In-Vitro-Protein digestibility: Pepsin-pancreatin digestibility was determined by the method of Akeson and Stahmann (1964). Digestibility by pepsin, trypsin and pancreatin in single systems was done under the same conditions as described by Abd El-Aal et al. (1986).

Functional properties: Water and oil absorption capacities were determined according to methods of Sosulski (1962) and Sousulski et al. (1976a) respectively. Emulsification capacity was measured by the method of Yasumatsu et al. (1972). Refined corn oil was used for oil absorption and emulsification capacities studies and distilled water for water absorption capacity. The results are expressed as gram H_2O or oil per gram flour sample. Foaming properties were measured by the method of Huffmann et al. (1975).

RESULTS AND DISCUSSION

Chemical composition:

The changes in some components of dry and boiled fenugreek seeds are given in Table (1). Total nitrogen was apparently increased due to boiling from 3.86% to 4.54%. This increase is mainly due to the loss of some soluble compounds such as simple sugars and soluble minerals. Also non-protein nitrogen fraction slightly increased due dissociation of protein molecules by heat. Also, reducing sugars, total ash and ether extract contents were decreased in the boiled seeds compared to control sample. The decrease was mainly due to both diffusion from the seeds to water and heat effect. As shown in Table (1) the used fenugreek seeds (boiled) still have high nitrogenous compounds.

Table (1) :

Effect of boiling on the chemical composition of fenugreek seeds* .

Component	Unboiled seeds	Boiled seeds
Total nitrogen	3.86	4.54
Non-protein nitrogen	0.37	0.41
Protein nitrogen	3.49	4.13
Reducing sugars (as glucose)	8.82	6.45
Total ash	4.03	3.25
ether extract	10.52	2.68

* Expressed on moisture free basis (means of two determinations) .

Table (2) :

Changes in albumin and globulin fractions of fenugreek seeds after boiling .

Sample	Albumin fraction		Globulin fraction	
	Soluble protein	%	Soluble protein	%
Unboiled seeds	17.15	71.23	3.20	13.28
Boiled seeds	4.65	16.39	2.91	10.25

Table (2) shows the effect of boiling on albumin and globulin, the major protein fractions in fenugreek seeds (Abd El-Aal and Rahma, 1986). The content of both fractions was decreased after boiling. The reduction rate was 77% for albumin and 22.82% for globulin respectively. This indicates that both protein fractions undergone a considerable dissociation by heat and leaching out to the solution during boiling treatment. Most of albumins are of low molecular weight therefore, their dissociation rate and losses were much higher than that of globulins.

Nutritional evaluation:

The in-vitro-protein digestibility of boiled and unboiled fenugreek seeds by different enzymes is given in Table (3). The boiled seeds showed higher digestibility by all used enzyme systems compared to unboiled sample. The digestibility of boiled seeds could be arranged in the following increasing order pepsin, trypsin, pancreatin and pepsin-pancreation. The results of unboiled seeds agree well with those reported by Abd El-Aal and Rahma (1986). The improvement of digestibility after boiling could be due to one or more of the following reasons : 1- destruction of trypsin inhibitor since, it is heat leabaile compound, 2- partial removal of tannins and phytic acid which are responsible for the observed low digestibility of the unboiled seeds (see Table 4), 3- heat denaturation of protein molecules and increased susceptibility towards enzymes attack. The observed improvement of in-vitro-protein digestibility of boiled sample is in agreement with that of Rahma and Narasinga Rao (1984) for boiled lupin seeds.

On boiling of fenugreek seeds both phytic acid and total tannins were reduced, Table (4). The reduction was considerable for phytic acid compared to tannins. Therefore, the phytic acid-minerals complexes is dissociated and that behined the large loss ($\sim$25%) in ash

Table (3) :

Effect of boiling on the in-vitro protein digestibility of fenugreek seeds .

Enzyme used	Digested protein (%)	
	Unboiled seeds	Boiled seeds
Pepsin	54.23	68.56
Trypsin	44.35	72.78
Pancreatin	48.15	79.64
Pepsin-pancreatin	71.57	90.93

Table (4) :

Effect of boiling on total tannins and phytic acide contents of fenugreek seeds .

Sample	Phytic acid * mg/gm flour	Total tannins * mg/gm flour
Unboiled seeds	10.7	2.9
Boiled seeds	5.7	2.4
% of Reduction	46.73	17.24

* Calculated and expressed on moisture free basis , (means of two determinations) .

content after boiling. Generally, the nutritional quality of fenugreek seeds improved on boiling due to increasing the protein digestibility and decreasing the contents of phytic acid and tannins.

Functional properties:

Protein solubility cureves of unboiled and boiled fenugreek seeds are illustrated in Fig. (1). Generally, the boiled seed proteins were less soluble than that of unboiled sample at all pH's. Also, the solubility at acidic and alkaline regions was high 64% and 73% (A) for unboiled and 30% ann 60% for boiled seeds (B) respectively. The minimum solubility pH for the proteins of both seeds was in the range of pH 4.0 to 5.0 as most of the other vegetable proteins. The solubility at neutral pH (6.0 to 7.0) was about 30% for both samples, therefore the boiled seeds could be used as a good source for protein in some non acid foods.

Water and oil absorption properties are given in Table (5). Both samples retained more water than oil. This may be due to the presence of carbohydrates such as starch and pentosans which have a hydrophilic nature. Also, the samples were not defatted therefore, the oil binding centres were already occupied. Boiling improved both water and oil absorption capacities compared to unboiled sample. The increase rate was 1.8 and 1.3 for water and oil absorption respectively. The same observation was reported by Narayana and Narasinga Rao (1982) for heat processed winged bean. Based on these data the boiled fenugreek seeds may be used in bakery products or in thick soups.

Emulsification capacity of fenugreek seeds was markdly decreased after boiling. The reduction was almost 50%. This was expected since, emulsion capacity is mainly due to the soluble protein (Kinsella, 1976). But it is interesting to note that dry fenugreek seed has a superior emulsification capacity than most of the other vegetable peroteins even soybean (Sosulski et al., 1976-b).

Table (5) :

Effect of boiling on some functional properties of full fat fenugreek seeds .

Functional properties	Fenugreek seed sample	
	Unboiled seeds	Boiled seeds
Water absorption gmH20/gm flour .	2.32	4.09
Oil absorption gm Oil/gm flour .	1.43	1.87
Emulsification capacity gm Oil/gm flour .	85.5	45.0
Foam capacity (% increase) .	18.0	30.0

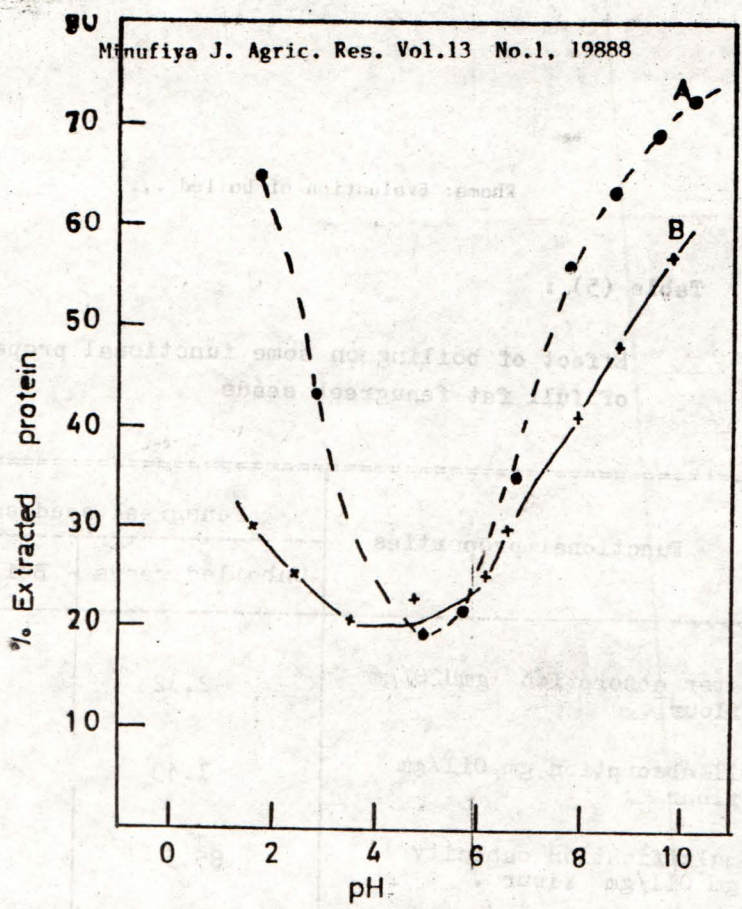

Fig.(1) : Protein solubility curves of fenugreek seeds . A,unboiled seeds B,boiled seeds .

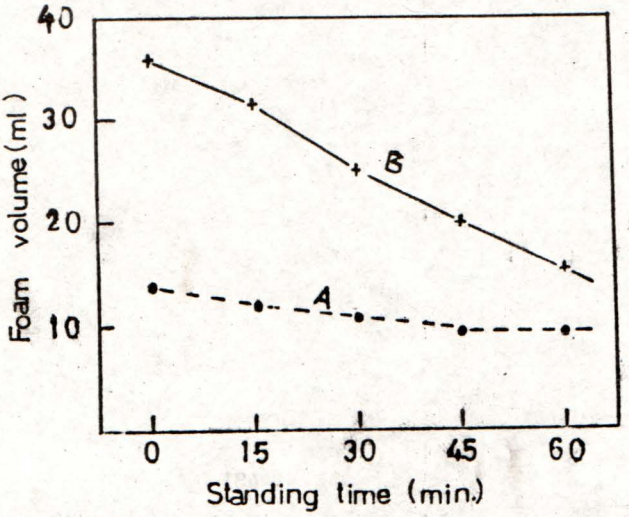

Fig.(2) : Foam stability of fenugreek seeds . A,unboiled seeds B,boiled seeds .

Foaming properties (capacity and stability) of treated and untreated fenugreek seeds are shown in Table (5) and Fig. (2). Foam capacity was improved after boiling although the protein solubility decreased. This may indicates that the protein solubility is not the only factor affecting foaming properties of fenugreek seeds. Foam capacity of boiled seeds was higher by 1.7 times than that of unboiled seeds. It is also worthwhile to report that the physical properties of the boiled seeds foam were, tan white in colour, fine air bubbles and compact in texture compared to white colour, bigger and loose air bubbles for unboiled samples. These properties particularly the texture of foam and air bubble size markdly affected the stability of foam (Fig. 2). Unboiled sample showed poor foam stability due to the higher rates of liquied release and bursting of formed air bubbles. Boiled sample showed superior foam volume at all the time of standing. Therefore, boiled fenugreek seeds flour could be used in cakes preparation along with wheat flour to improve the size and texture of the product, also it will not affect the colour because it is light yellow in colour.

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