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The protein nutritive value of bouza and its ingredients

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With 2 figures and 5 tables

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In Egypt, cereals play an important part in the diet, providing 70 % of the calories and 66.5 % of the protein intake (1). For economic reasons, the protein intake of the population cannot be increased by an increase of animal proteins. The food real situation can be appraised by the application of modern food science and food technology. There are also techniques to which little attention is given in present day sophisticated food technology, but which are particularly prevalent in empirical forms among primitive people. The application of these techniques are concerned with the preparation of fermented foods (2) of which *bouza* is a good example (3).

As the main object of the present work was to determine the increase of the protein nutritive value of dietary regimens by complementation with fermented foods, it was found essential to determine the protein nutritive value of *bouza* at different periods of fermentation and that of the ingredients.

Experimental

Preparation of bouza

Bouza is now prepared in Egypt from wheat grains, *Triticum vulgaris*. Coarsely grated wheat grains are placed in large wooden basins and kneaded with water into a dough. The dough is cut into thick loaves, which are baked very lightly.

Some of the wheat grains, about a quarter of the total amount of wheat used, is moistened with water and left to germinate for 3 to 5 days, then dried in the sun and coarsely ground. They were mixed with the bread loaves and soaked in water in a wooden barrel. Some *bouza* from a previous brewing is added, left to ferment for 24 h. at room temperature. After this period, the mixture is passed through a sieve to remove the solid materials. The liquor is made to the required dilution with water and becomes ready for use (first day or 24-hour *bouza*).

Preparation of samples for analysis

Samples of *bouza* (5 litres) and its ingredients (1 kg. of each) were collected from five different shops in Cairo. They were transferred to the laboratory in a portable ice box. One portion of *bouza* (first day) was kept at -20°C , the two other portions were kept in small wooden barrels, at room temperature for 24 and 48 hours, thus representing second and third day samples (48 and 72 h.). After each period, the samples were stored in the deep freeze till used.

Methods

Bouza and its ingredients were hydrolysed with 6 N-hydrochloric acid. The amino acid pattern and contents were determined as described by Morcos, Hegazi and El-Damhougy (4); while the free amino acids were estimated by the method of Ya Pin Lee and Tunckazu (5).

The net protein utilization was determined on weanling hooded rats following the method described by Miller and Bender (6).

To study the effects of *bouza* or its ingredients on supplementing stewed beans recipe, 400 g. of stewed beans (*Vicia faba*), corresponding to 100 g. dry beans, to which were added cotton seed oil, lemon juice and table salt were mixed in a blender, then dried under vacuum. A loaf and half of Arabic bread (150 g.) were added thus forming diet 1. 75 g. of bread were replaced by equal amounts of wheat, germinated wheat, bread of *bouza* or dry *bouza* from first, second or third day samples to form diets 2-7 respectively (Table 1). The crude protein content of each diet was determined giving the values of 17.4, 18, 17, 18, 17, 19, and 19 % respectively.

The *koshari* recipe was prepared from lentils and polished rice. Each ingredient was boiled separately till soft. When done they were mixed together and seasoned with salt.

To the recipes prepared 50 g. of dry *bouza* 72 hours samples were added (table 1 b). The crude protein content of the *koshari* recipes was found to be 16.3 and 16.6 % respectively.

Results and discussion

Murata, Ikehata and Miyamoto (7) reported that fermentation of soya beans resulted in an increase in the free amino acids ranging from 1-85

Table 1. Composition of experimental diets used
a) Stewed bean recipes

Ingredients	Diets in g.						
	1	2	3	4	5	6	7
Stewed beans	100	100	100	100	100	100	100
Cotton seed oil	10	10	10	10	10	10	10
Lentils	5	5	5	5	5	5	5
Common dry bread	150	75	75	75	75	75	75
Wheat	0	75	0	0	0	0	0
Germinated wheat	0	0	75	0	0	0	0
Bread of bouza	0	0	0	75	0	0	0
Bouza first day	0	0	0	0	75	0	0
Bouza (second day)	0	0	0	0	0	75	0
Bouza (third day)	0	0	0	0	0	0	75

b) Koshari recipes

Ingredients	Diets in g.	
	1	2
Rice	80	80
Lentils	40	40
Fat	10	10
Bouza fermented for 72 hours (dry)	0	50
Corn starch	50	0

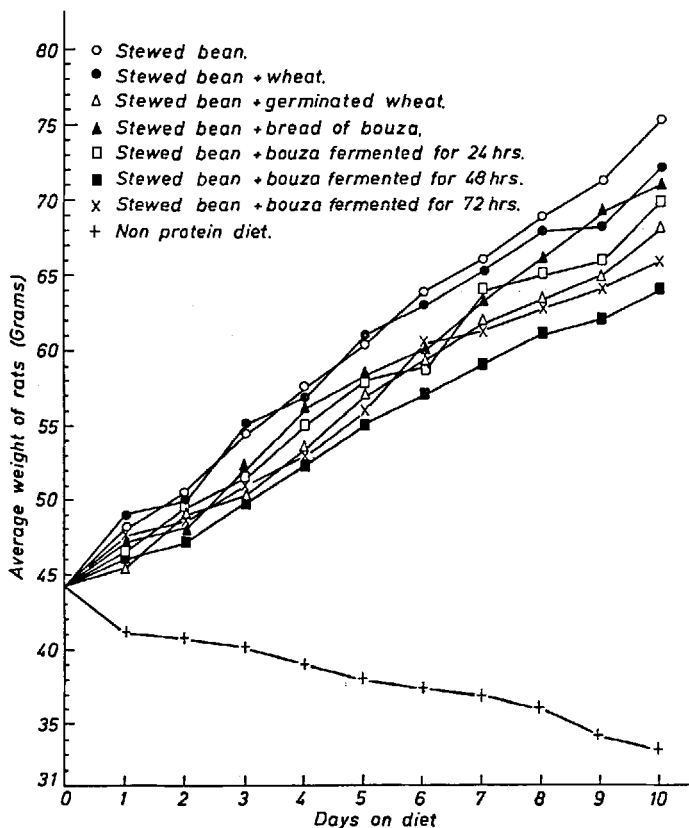


Fig. 1

times as much as that of unfermented samples. Such observations agree quite well with our finding which showed progressive increase during fermentation of bread (table 2). *Stilling* and *Hackler* (8) found that fermentation of tempeh for 72 hours led to a noticeable increase in both the free amino acids and ammonia, but in general, most of the amino acids were unchanged as fermentation progressed with exception of tryptophan which was significantly higher in 24 hours fermented tempeh but declined thereafter.

Table 2. Total free α -amino acids in bouza and its ingredients (mg./100 g.)

Commodity	Total free α -amino acids mg./100 g.
Wheat	87.0
Germinated wheat	450.0
Bread	230.0
First day bouza	986.0
Second day bouza	1100.0
Third day bouza	1225.0

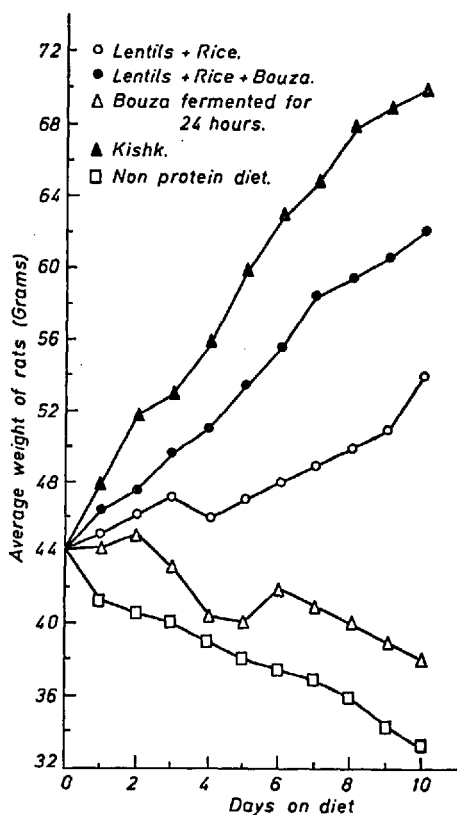


Fig. 2

The acid and alkali hydrolysis of the proteins of *bouza* and its ingredients revealed the presence of the same amino acids: arginine, cystine, histidine, isoleucine, leucine, lysine, methionine, threonine, tryptophan, tyrosine and valine. When these amino acids were quantitatively determined, it was seen that on germination of wheat there was an increase in each amino acid (table 3). This increase is due to the proteolytic action of enzymes which involved during germination leading to extensive break down of proteins accompanied by inter-conversion and utilization of amino acids and the production of new nitrogen compounds (9). Such observations agree quite well with that previously reported by Boulter and Barber (9), and by Hussain, Khan, Yasin and Saha (10) and by Fertman and Lazareva (11).

In the bread of *bouza*, the values for the amino acids were lowered, some of them were markedly decreased while others were slightly affected (table 3). This may be due to the action of heat and to the consumption of the amino acids in Maillard reaction.

After 24 h. of fermentation, a marked increase in the amount of each amino acid was noticed. Compared to their amounts in wheat, tryptophan increased by 53 %, leucine and isoleucine by 48 %, histidine by 56 %, ty-

Table 3. Amino acid content of bouza and its ingredients (mean of 5 samples) (mg./g. N) compared with FAO Provisional pattern

Amino acids	Wheat	Germi- nated wheat	Bread	First day bouza	Second day bouza	Third day bouza	L.S.D.	FAO Provisional pattern
Phenylalanine	303	305	292	182	231	176	12.14	180
Threonine	196	256	190	238	247	217	N.S.	180
Isoleucine								
+ leucine	597	725	560	905	744	668	21.20	576
Histidine	134	200	121	217	207	219	N.S.	—
Arginine	275	320	230	327	280	213	N.S.	—
Valine	240	340	202	287	252	197	27.90	270
Tryptophan	80	99	72	141	148	178	5.30	90
Lysine	184	240	160	191	238	211	25.76	270
Tyrosine	212	338	188	332	334	368	N.S.	180
Cystine	126	140	105	185	150	139	8.97	126
Methionine	108	138	100	177	134	121	13.52	144

rosine by 53 %, methionine by 58 %, cystine by 42 %, arginine by 34 %, threonine by 21 %, and valine by 21 %, lysine concentration was not affected by fermentation while phenylalanine was decreased by 34 %.

Identical changes were reported by Sano (12) in his study on the amino acids of "nato" prepared by fermenting soybean with *Bacillus subtilis*. When fermenting black gram and rice, Radhakrishna Rao (13) found an increase in the methionine content of 20 %.

When fermentation proceeds for longer time, there was a nonsignificant decrease in the concentration of individual amino acids. Stilling and Hackler (8), in their study on the effect of time on the processing of

Table 4. Net protein utilization of the diets*

a) Bouza fermented for 24, 48 and 72 hours (first, second and third day)	
Food	N.P.U.
Bouza fermented for 24 hours	44
Bouza fermented for 48 hours	39
Bouza fermented for 72 hours	44.2
b) Stewed broad bean recipe supplemented with bouza and its ingredients	
Stewed bean + bread	43
Stewed bean + bread + wheat	44
Stewed bean + bread + bread + germinated wheat	45
Stewed bean + bread + bread of bouza	46
Stewed bean + bread + first day bouza	52
Stewed bean + bread + second day bouza	43
Stewed bean + bread + third day bouza	43
c) Koshari recipe supplemented with bouza fermented for 72 hours	
Rice + lentils	48.4
Rice + lentils + bouza fermented for 72 hours	50

* mean of 3 assays

Table 5. The amount of food consumed by rats during 10 days

Food	Food consumed in g.
1 - Stewed bean + bread	400
2 - Stewed bean + wheat bread	467
3 - Stewed bean + germinated bread	428
4 - Stewed bean + bread + bread of bouza	361
5 - Bouza fermented for 24 hours supplemented with stewed bean	465
6 - Bouza fermented for 48 hours supplemented with stewed bean	440
7 - Bouza fermented for 72 hours supplemented with stewed bean	418
Rice + lentils	196
Bouza fermented for 72 hours supplemented with koshari recipes (rice + lentils mixture)	219

tempeh, reported that when soybean was fermented for 72 hours, the concentration of the amino acids were slightly decreased or even unchanged while *Steinkraus, Hand, Van Buren* and *Hackler* (14) showed that with increasing the time of fermentation, the amount of lysine and methionine of tempeh was reduced.

Comparing the amino acid content of *bouza* or its ingredients with the FAO provisional pattern for amino acids, it is seen that although the amino acids: valine, tryptophan, methionine, and lysine are present in lower values in both of wheat and the bread of *bouza*; fermentation resulted in raising their amounts with the exception of lysine which was still limiting.

The effect of supplementing a popular recipe such as stewed beans and koshari with *bouza* was studied. The net protein utilization of stewed bean dish was 43, supplementing with *bouza* resulted in a slight increase in the net protein utilization. While with the first day *bouza* it increased markedly being 52 (table 4). No change in the net protein utilization of the recipe was noticed when supplementing with the second or third day *bouza*. The high sugar and the alcohol content of the first day *bouza* made it more acceptable to animals as shown by the high food intake (table 5).

When koshari dish was supplemented with third day *bouza* its net protein utilization was increased slightly from 48.4 to 50. Probably if the first day *bouza* was used it may cause a marked increase in the N. P. U. of the koshari dish.

If *bouza* was to be prepared in factories under satisfactory hygienic conditions, one would obtain a good drink of a high nutritional value.

Summary

1. The amino acid pattern of *bouza* and its ingredients were determined. On germination of wheat, the values for threonine, isoleucine + leucine, histidine, arginine, valine, lysine, thyrosine and methionine were increased with exception of phenylalanine. Marked increase was also noticed during the first period of fermentation (24 h.).

2. Reduction in most of the amino acids was observed on the second and third days of fermentation. Tryptophan increased markedly during the course of fermentation.
3. The total free amino acids increased during germination of wheat; a progressive increase in the total free amino acids was also observed during fermentation of *bouza*.
4. Animal experiments showed that the net protein utilization of a diet of stewed beans and bread, a popular recipe in Egypt, increased from 43 to 52 when supplemented with *bouza* (first day samples), while the rice and lentils recipe was slightly increased from 48.4 to 50 when supplemented with *bouza* (third day samples).

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