Unconventional protein sources: apricot seed kernels

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In the early 1960 wide-spread interest was aroused in the international community about the development of low-cost nutritious food from unconventional sources. Partly the excitement was caused by increased recognition of the importance of malnutrition, but uncertainty about continuing supply from existing nutritious sources played an important role.

Protein malnutrition is without doubt the main nutritional problem facing low-income countries. The family of food that has received the most attention as fortifiers or ingredients of the formulated foods are the oilseeds. The principal difficulties in exploiting them for human consumption are color, toxic factors, digestibility and palatability.

Single cell protein, fish protein concentrate, leaf protein concentrate and wheat protein concentrate are used primarily in animal feed. Whether these protein sources can be incorporated into diets or as a base in formulated foods merits considerable exploitation.

In the present study, some by-products of food processings were evaluated as unconventional sources of food proteins. One of these by-products are apricot seed (Prunus armeniaca) kernels.

Materials and methods

Selection and preparation of samples:

1. Hamawy apricot kernels (Sweet): Dried apricot fruits (var. Hamawy) were obtained from El-Kharga oases. Kernels were removed manually and ground for analysis.

2. Amar apricot kernels (bitter): The seed was obtained as by-products form kaha (food processing factory). Kernels were manually removed, and divided into two parts. The first part was ground for analysis. The second one was treated in different ways to reach the best method for removing bitterness. The best method found was by boiling the kernels for 30 minutes in 0.1% sodium bicarbonate solution, soaking for 24 hours in running tap water and then drying at 100 °C. The dried kernels were ground for analysis.

Chemical analysis

Moisture, crude protein, ether extract, ash, and phosphorus were determined according to the methods recommended by the Association of Official Agricultural Chemists (1965). Soluble proteins were extracted at 20 °C, and nitrogen was determined in both the extract and residue. Fiber was determined according to Pearson (1962). The method used for iron determination was that of Elvehjem (1930).
Calcium was determined according to Kramer (1921). Carbohydrate content was calculated by difference. The dried defatted samples were subjected to acid hydrolysis for 24 hours. The amino acids in the hydrolysates were separated by the two-dimensional paper chromatographic technique of Block et al. (1958). The solvents used were butanol, acetic acid, and water (4 : 1 : 5) in the first run and 0.3 % ammonia in 80 % phenol in the second run.

Quantitative determination was made whenever possible for some of the separated amino acids using the method of Giri et al. (1952). Tryptophan was not determined, as it is destroyed by acid hydrolysis.

**Biological evaluation of the seed's protein**

The following basal diet (Campbell, 1961) was used:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn starch</td>
<td>80 g</td>
</tr>
<tr>
<td>Cotton seed oil</td>
<td>10 g</td>
</tr>
<tr>
<td>Cellulose</td>
<td>5 g</td>
</tr>
<tr>
<td>Salt mixture</td>
<td>4 g</td>
</tr>
<tr>
<td>Vitamin mixture</td>
<td>1 g</td>
</tr>
</tbody>
</table>

The salt mixture used was that of Hubbel et al. (1937), and the vitamin mixture was that of Campbell (1961). The dried defatted samples were added at the expense of starch to produce 10 % protein level. Casein was used in the standard diet.

Determination of the protein efficiency ratio (P.E.R.): The method used was that of Campbell (1961). Weanling albino rats of a single strain, 20-23 days old, were used. The rats were divided into groups of 6 animals for each diet. The groups were equalized as nearly as possible with respect to sex and weight. Diets and water were supplied ad libitum. The experiment was extended to four weeks, at the end of which calculations of the protein efficiency ratios (P.E.R.) were made for each rat.

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P.E.R. = \frac{g \text{ gain in body weight}}{g \text{ protein intake}}
\]

P.E.R. for experimental diets were recalculated as percentage of that for casein.

Determination of the net protein ratio (N.P.R.): A control group of rats of nearly equal weight and age as in P.E.R. experiment was fed a protein-free (basal) diet for 10 days to determine the loss in weight corresponding to the maintenance requirements of the rats. An approximate estimate of N.P.R. was done for the four-week period from the loss in weight of group means over 10-day period.

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N.P.R. = \frac{\text{weight gain of test protein group}}{\text{weight loss of the protein-free diet group}}
\]

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N.P.R. = \frac{\text{weight gain of test protein group}}{\text{protein intake}} + \frac{\text{weight loss of the protein-free diet group}}{\text{protein intake}}
\]

**Blood analysis**

At the end of the experimental period, rats were killed by chloroform, and blood samples were taken by cardiopuncture. The total serum protein was determined by Kjeldahl method according to the A.O.A.C. (1965). Serum samples of 0.2 ml were subjected to electrophoretic separation of proteins. The apparatus used was that of Elphor and the separation was carried out at pH 8.9 for 18 hours using Durrum method (1950). The dye used was bromophenol blue. Elution of the stained bands was carried out using 0.5 % solution, and the albumin/globulin ratio was determined colorimetrically. The free non-essential/essential amino acid ratio was determined using the method of Abdou and Awadalla (1973).