The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre’s activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Government of Canada; its policies, however, are set by an international Board of Governors. The Centre’s headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

© 1979 International Development Research Centre
Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa

Hawtin, G.C.
Chancellor, G.J.
International Center for Agricultural Research in the Dry Areas, Aleppo SY
IDRC-126e


/IDRC publication/. Compilation of workshop papers on /legume/ /food production/ in the /Middle East/ and /North Africa/ — discusses agro/bio-climatology/ and /cultivation system/s, /nutrition/al value and /food composition/; /plant production/ (particularly of /chickpea/s, /lentil/s, and /faba bean/s), /agricultural research/, /cultivation practice/s for /plant protection/; /plant disease/s, /insect/ /pest/s, /disease resistance/, /weed control/ problems (use of /herbicide/s in /arid zone/s); /plant breeding/ and /genetic improvement/. /IDRC mentioned/, /list of participants/.


Microfiche edition available
Food Legume Improvement and Development

Proceedings of a workshop held at the University of Aleppo, Aleppo, Syria, 2–7 May 1978

Editors: Geoffrey C. Hawtin and George J. Chancellor

Published by the
International Center for Agricultural Research in the Dry Areas and the
International Development Research Centre

The views expressed in this publication are those of the individual author(s) and do not necessarily represent the views of ICARDA or IDRC.
## Contents

**Preface** .................................................................................................................. 4
**Foreword** .................................................................................................................. 5

### Section I  An Introduction to Food Legumes in the Region

Some aspects of the agroclimatology of West Asia and North Africa  
**Hazel C. Harris** ................................................................................................. 7
Food legume production: the contribution of West Asia and North Africa to the world situation  
**F.M. Hamawi** ............................................................................................... 15
Food legumes in the farming system: a case study from Northern Syria  
**David Gibbon and Adrienne Martin** ............................................................. 23
Nutritional quality and importance of food legumes in the Middle Eastern diet  
**Raja Tannous, Salah Abu-Shakra, and Abdul Hamid Hallab** .................. 29

### Section II  The Present Production and Improvement Situation

Food legumes in Algeria  
**Walid Khayrallah and Lounes Hachemi** ..................................................... 33
Production and improvement of grain legumes in Egypt  
**Ali A. Ibrahim, Abdullah M. Nassib, and Mohamed El-Sherbeeny** .......... 39
Food legume production in the Hashemite Kingdom of Jordan  
**M. Abi Antoun and A. Quol** ........................................................................ 47
Food legume production and improvement in Iran  
**M.C. Amirshahi** ............................................................................................ 51
Food legumes in Iraq  
**Mahmoud A. Mayouf** ................................................................................ 55
Food legume research and development in the Sudan  
**Farouk A. Salih** ............................................................................................ 58
Food legume improvement in Tunisia  
**M. Bouslama and M. Djerbi** .................................................................. 65
Food legume production and improvement in Lebanon  
**M. Mustafa, and M. Shehadeh** ................................................................. 69
Grain legume production in Turkey  
**D. Eser** ......................................................................................................... 71
Food legume research and production in Cyprus  
**J. Photiades and G. Alexandrou** ................................................................. 75
Broad beans (Vicia faba) and dry peas (Pisum sativum) in Ethiopia  
**Asfaw Telaye** .................................................................................................. 80
Food legumes in Syria  
**Sadek El-Matt** ........................................................................................... 85
Food legume improvement in the People’s Democratic Republic of Yemen  
**Shafiq Mohsin Atta** .................................................................................... 88
Food legume production in Libya  
**Ali Salim** ...................................................................................................... 90
Status of food legume production in Afghanistan  
**N. Wassimi** ................................................................................................... 91
Food legumes in India  
**A.S. Tiwari** .................................................................................................. 94

### Section III  Disease Problems on Legume Crops

Diseases of major food legume crops in Syria  
**S.B. Hanounik** ............................................................................................. 98
Food legume diseases in North Africa  
**M. Djerbi, A. Mlaiki, and M. Bouslama** ...................................................... 103
Food legume diseases in Ethiopia  
**Alemu Mengistu** .......................................................................................... 106
Diseases of broad beans (Vicia faba) in the Sudan  
**Mustafa M. Hussein and Sami O. Freigoun** .................................................. 109

### Section IV  Major Pests and Weeds of Food Legumes

Insect pests of food legumes in the Middle East  
**Nasri S. Kawar** ............................................................................................ 112
Insect pests of chick-pea and lentils in the countries of the Eastern Mediterranean: a review  
**G. Hariri** ....................................................................................................... 120
Some insect pests of leguminous crops in Syria  
**Ara A. Kemkemian** ...................................................................................... 124
The biology and control of Orobanche: a review  
**A.R. Saghir and F. Dastghieh** ....................................................................... 126
Broomrape (Orobanche crenata) resistance in broad beans: breeding work in Egypt  
**Abdullah M. Nassib, Ali A. Ibrahim, and Hamdy A. Saber** ...................... 133
Accentuation of weed control problems in the dry areas with relevance to herbicides in food legumes  
**F. Basler** ...................................................................................................... 136
Nutritional Quality and Importance of Food Legumes in the Middle Eastern Diet

Raja Tannous, Salah Abu-Shakra, and Abdul Hamid Hallab

Faculty of Agricultural Sciences, American University of Beirut, Beirut, Lebanon

Grain legumes constitute one of the most important sources of food nutrients to people in many countries of the world, particularly in the Middle East. Their main nutritional value lies in the fact that they are very important sources of dietary vegetable proteins. They provide 15–30% of the total protein content of average diets in this part of the world, making them second only to cereals in dietary importance. Grain legumes are also good sources of the vitamins thiamine and niacin and the minerals calcium and iron, but contain little fat, carotene, or ascorbic acid.

The food legumes commonly consumed in the Middle East together with their Arabic names are: broad beans (Vicia faba), “ful”; chick-peas (Cicer arietinum), “homos”; lentils (Lens culinaris), “adas”; fenugreek (Trigonella foenumgraecum), “hilbeh”; lupins (Lupinus spp.), “turmos”; peas (Pisum sativum), “bazella”; and common beans (Phaseolus vulgaris), “fasulya nashef”. Of these, broad beans, chick-peas, and lentils are the most important and are probably consumed daily in one way or another by a large part of the population of the Middle East. During the harvesting season the green seeds of broad beans, chick-peas, and lupins are commonly consumed as an interim food, the latter only after debittering. Fenugreek is used mainly as a condiment, particularly in the very popular Armenian dish “basterma,” and peas and common beans are used in a stew with meat and usually consumed with rice. The most common legume dishes consumed in the area are: broad bean dip, “ful moudamas,” which is frequently eaten as a breakfast food; chick-pea dip, “hommos bitehineh,” eaten at any time; rice and lentils, “mujaddarah,” and common bean stew, frequently served at schools and other institutions; “falafel,” often eaten as a sandwich; and lentil soup, which may be eaten at any meal.

Nutritional Composition of Grain Legumes

The importance of legumes as a protein source is clearly illustrated in Table 1. The average protein content varies from 20 to 40%, which is approximately triple that of cereals. However, with the exception of chick-pea and lupin, the fat content of these seeds is rather low. The nutritive value of legumes changes with the development of the seed, the fat content increasing until 21 days after flowering and thereafter remaining stable, and the protein content remaining the same throughout despite the lysine content rising to a maximum after 14 days and the sulphur amino acids after 42 days. This may have a bearing on the fact that chick-pea seeds are frequently consumed green during harvest.

In any evaluation of dietary value, the protein quality of a food should be considered of equal importance to the total protein content. An evaluation of quality on the basis of the chemical score of the most limiting amino acids (in this case the sulphur amino acids) shows chick-pea to contain the best quality protein (score = 61), followed by lupin (55), and lentil (44), with broad bean (34) showing the lowest quality.

Most dry legumes are good sources of thiamine and niacin, but with the exception of green chick-peas, are poor sources of carotene and vitamin C. Legumes also have a high
### Table 1. Chemical composition of grain legumes (grams per 100 edible portion).

<table>
<thead>
<tr>
<th>Legume</th>
<th>Protein</th>
<th>Fat</th>
<th>NFE</th>
<th>Ash</th>
<th>Fiber</th>
<th>Water</th>
<th>Energy (Kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broad beans, green</td>
<td>5.2</td>
<td>9.4</td>
<td>9.8</td>
<td>0.8</td>
<td>2.0</td>
<td>81.8</td>
<td>72</td>
</tr>
<tr>
<td>Broad beans, dry</td>
<td>25.0</td>
<td>1.8</td>
<td>53.7</td>
<td>3.0</td>
<td>5.9</td>
<td>10.6</td>
<td>354</td>
</tr>
<tr>
<td>Chick-pea, green</td>
<td>5.9</td>
<td>1.8</td>
<td>17.5</td>
<td>0.9</td>
<td>1.3</td>
<td>72.6</td>
<td>99</td>
</tr>
<tr>
<td>Chick-pea, dry</td>
<td>19.2</td>
<td>6.2</td>
<td>56.7</td>
<td>3.0</td>
<td>3.4</td>
<td>11.5</td>
<td>376</td>
</tr>
<tr>
<td>Lentils</td>
<td>23.7</td>
<td>1.3</td>
<td>57.4</td>
<td>2.2</td>
<td>3.2</td>
<td>12.2</td>
<td>351</td>
</tr>
<tr>
<td>Lupin</td>
<td>40.0</td>
<td>13.0</td>
<td>26.0</td>
<td>3.0</td>
<td>9.0</td>
<td>9.0</td>
<td>420</td>
</tr>
<tr>
<td>Fenugreek</td>
<td>29.6</td>
<td>5.2</td>
<td>50.0</td>
<td>3.3</td>
<td>7.2</td>
<td>8.6</td>
<td>365</td>
</tr>
</tbody>
</table>

### Table 2. Nutritional composition of some Middle Eastern legume dishes (per 100 g edible portion).

<table>
<thead>
<tr>
<th>Legume</th>
<th>Water</th>
<th>Protein</th>
<th>Fat</th>
<th>Energy (Kcal)</th>
<th>Ca, mg</th>
<th>Fe, mg</th>
<th>Thiamine, mg</th>
<th>Riboflavin, mg</th>
<th>Niacin, mg</th>
<th>Lysine, mg/gN</th>
<th>Total S-AA, mg/gN</th>
<th>FAO Score 1957</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broad bean dip (ful moudamas)</td>
<td>66.1</td>
<td>9.1</td>
<td>3.1</td>
<td>151</td>
<td>43</td>
<td>2.2</td>
<td>.15</td>
<td>.1</td>
<td>.9</td>
<td>346</td>
<td>129</td>
<td>48</td>
</tr>
<tr>
<td>Chick-pea dip (homos bithineh)</td>
<td>49.5</td>
<td>9.6</td>
<td>19.7</td>
<td>300</td>
<td>57</td>
<td>4.2</td>
<td>.33</td>
<td>.08</td>
<td>1.2</td>
<td>330</td>
<td>195</td>
<td>72</td>
</tr>
<tr>
<td>Lentil soup</td>
<td>83</td>
<td>4.7</td>
<td>.8</td>
<td>72</td>
<td>14</td>
<td>1.4</td>
<td>.09</td>
<td>.03</td>
<td>.4</td>
<td>380</td>
<td>130</td>
<td>48</td>
</tr>
<tr>
<td>Lentil + rice (mujaddarah)</td>
<td>64.5</td>
<td>6.2</td>
<td>5.6</td>
<td>170</td>
<td>15</td>
<td>1.4</td>
<td>.09</td>
<td>.05</td>
<td>.9</td>
<td>386</td>
<td>163</td>
<td>60</td>
</tr>
<tr>
<td>Falafel sandwich</td>
<td>28.6</td>
<td>5.8</td>
<td>12.0</td>
<td>195</td>
<td>40</td>
<td>5.9</td>
<td>.06</td>
<td>.06</td>
<td>.5</td>
<td>365</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Effect of cooking (autoclaving at 121 °C) on antinutritional factors in legume seeds.

<table>
<thead>
<tr>
<th>Legume</th>
<th>Hemagglutinating activity</th>
<th>Antitrypsin activity</th>
<th>Mortalitya</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>20 min</td>
<td>None</td>
</tr>
<tr>
<td>Broad beans</td>
<td>80</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chick-peas</td>
<td>0</td>
<td>0</td>
<td>8.4</td>
</tr>
<tr>
<td>Lentils</td>
<td>640</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pea</td>
<td>80</td>
<td>0</td>
<td>8.4</td>
</tr>
<tr>
<td>Common bean</td>
<td>8200</td>
<td>20</td>
<td>9.6</td>
</tr>
</tbody>
</table>

a Number of rats dead (out of 10) after 4 weeks.
content of iron and other minerals, but the availability of these minerals may not be very high.

**Nutritional Evaluation of Legume Dishes**

Because grain legumes are consumed in the form of composite dishes, the real dietary value of the food must be considered in terms of the nutritional value of the complete dishes (Table 2) and the frequency with which these dishes are consumed. Furthermore, when a specific food or dish is continuously consumed, specific nutritional implications must be considered. The digestibility, physiological availability of certain nutrients, presence of antinutritional factors, problems of flatulence, and effects of processing all become more important in this case due to an accumulation of effects. For example, where legumes provide the major source of protein in the diet, the nutritional quality of the legume proteins becomes a much more limiting factor. The protein quality of chick-peas is higher than the other legumes, and the protein quality of the most common legume dish “hommos” is correspondingly high (Table 2). Therefore, the frequent consumption of chick-pea dip will be better than any of the other legume foods. To achieve a more balanced diet, legume foods may be supplemented with other foodstuffs. From the protein quality point of view, bread is an ideal complement to legume foods. It is, thus, nutritionally very fortunate that most legume dishes are consumed with bread. The notable deficiencies in legume foods, namely carotene and vitamin C, may be remedied by the inclusion in the diet of other foods rich in these nutrients.

**Effects of Processing on Nutritional Quality**

Uncooked legume seeds contain antinutritional factors that can be very toxic if consumed in large quantities (Table 3). Consideration of only two factors, namely hemoglutinating and antitrypsin (although other factors may well be responsible for the mortality of animals fed on uncooked beans), illustrates that adequate cooking will render them safe for consumption.

In general, cooking also improves protein quality in legume foods, but it should be noted that prolonged cooking (longer than 5 min at 121 °C) will not improve quality further.

**Utilization of Grain Legume Flours as Supplements**

Because grain legumes are a good source of dietary protein, it is envisaged that legume flours could be profitably used as supplements to improve the dietary protein quantity and quality of other local foods. Several investigations along these lines have been carried out at the Faculty of Agricultural Sciences with legume flours, protein isolates, and concentrates utilized as supplements to weaning food mixtures, Arabic bread, biscuits, and other foodstuffs. It was generally found from these investigations that legume flours can be used in limited quantities to improve the protein quality of local foods without seriously affecting their taste, acceptability, or other quality factors.

**Cooking Quality of Food Legumes**

Dry legume seeds normally require a relatively long time to cook. Seeds of broad bean, chick-pea, common bean, and, to a lesser extent lentil, are soaked in water overnight before cooking as a means of reducing the cooking time and, in some instances, small amounts of NaHCO₃ may be added to chick-peas and broad beans to reduce this even further. Not all food legumes are eaten cooked, however, and unprocessed dry seeds of many of the legumes are often used directly in the preparation of traditional dishes in the Middle East and neighbouring countries.
The cooking process serves to soften the hard legume seeds by improving the plasticity of the cell walls, thereby facilitating cell expansion and the reduction of cellular adhesion. Some legume seeds are more difficult to cook than others and this is thought to be due to the presence of insoluble pectins in the middle lamella of the cell wall. This may be accentuated by the formation of further insoluble calcium and magnesium pectates in these middle lamellae when the Ca or Mg content of either the seed or the cooking water is high.

It has been reported that cooking quality may be associated with the ratio of monovalent to divalent cations and with the phytin and phosphorus contents of the seed. It seems that a high availability of phosphorus in the soil could contribute to a high phytin content in the seed and consequently to good cooking; and it has been suggested that the action of phytin in this respect is as a Ca absorbent, which thus prevents the formation of calcium pectate. Besides the relative contents of phytin, Ca, Mg, and free pectin in the seed, it has also been reported that the thickness of the palisade layer, and the lignin and alpha-cellulose content of the seed coat, are probably important factors affecting the cooking quality of legume seeds. Cooking quality has further been found to be affected by storage but only when the moisture content of the seed is greater than 10%.

Work at the Faculty of Agricultural Sciences on these aspects has been confined to studies on lentils. A standard procedure for determining cooking quality has been evolved and all experimental results are expressed as a cooking index on a scale of 1–15, where good quality is expressed by low scores. It has been found that quality is significantly influenced by mineral nutrition, with adequate levels of both the major and the trace elements contributing to good cooking. Plants receiving adequate levels of the important elements and a high level of potassium produced the fastest cooking lentil seed, and a combination of high levels of potassium and sodium in the seed was also associated with good cooking quality. No direct relation was found, however, between the content of phytic acid in the seed and cooking quality.

Various growth regulators or the chelating agent EDTA, applied as foliar sprays during early crop development, had no significant effect on the cooking quality.

The results of field experiments to study the effects of seed maturity on cooking quality demonstrate that cooking time decreases markedly with increasing maturity.

It can be seen that food legumes, in a variety of different forms, contribute considerably to the diets of the people of the Middle East, especially in terms of high quality protein. However, the presence of various objectionable endogenous factors, such as antinutritional factors, flatulence, and poor cooking quality, tends to limit their more widespread utilization in human diets. The neutralization and minimization of the effects of these factors should be the prime focus for future research geared to increasing the consumption of these important dietary components.