# Consultants' Meeting on Uses of Grain Legumes

27-30 March 1989
ICRISAT Center

## Program
## Summaries
## Information for Participants


ICARDA
International Center for Agricultural Research in the Dry Areas
P O Box 5466, Aleppo, Syria

FAO
Food and Agriculture Organization
Regional Office for Asia and the Pacific
Bangkok 10200, Thailand

ICRISAT
International Crops Research Institute for the Semi-Arid Tropics
ICRISAT Patancheru, Andhra Pradesh 502 324, India

# Consultants' Meeting on Uses of Grain Legumes

## 27-30 March 1989

## ICRISAT Center, Patancheru
## Andhra Pradesh, India

Sponsored by

**International Crops Research Institute for the Semi-arid Tropics (ICRISAT),**

**International Center for Agricultural Research in the Dry Areas (ICARDA), and**

**Food and Agriculture Organization of the United Nations (FAO)**

## Objectives of the Meeting

The purpose of holding the Consultants' Meeting on Uses of Grain Legumes is to discuss the current utilization aspects of grains of chickpea (*Cicer arietinum*), pigeonpea (*Cajanus cajan*), and groundnut (*Arachis hypogea*) with emphasis on diversification of end uses. Invited experts will assess the latest development and the application of various techniques in this field for formulating immediate and long-range plans to improve the uses of ICRISAT's mandate legumes.

The following are the meeting objectives:

To review the existing knowledge, on the uses of chickpea, pigeonpea, and groundnut grain, and to identify:

- o areas that require further research and development,
- o research ideas to provide novel and alternative uses of these legumes to help structure the future research thrust,
- o areas for collaborative research, and
- o training needs.

**Organizing Committee**

R. Jambunathan
M.C. Saxena
H.A. van Rheenen
Laxman Singh
S.N. Nigam
D.G. Faris
S.D. Hall
Umaid Singh
T.R.K. Satyanarayana

**Scientific Editor**

R. Jambunathan

**Proceedings Editor**

Vithal Rajan

**Reception/Secretarial Assistance**

T.R.K. Satyanarayana
P.R. Murthy
Santosh Gurtu
P.V. Rao
T.S. Noel Prashanth
K.D.V. Prasad

# PROGRAM

**Venue : Conference Hall - Building 212**

**Monday, 27 March 1989**

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|---|---|---|
| 0745 - 0830 | **Registration - Reception Area - Building 212** | |

## SESSION I - Inauguration

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|---|---|---|
| **Chairperson** | **: J.L. Monteith** | **Rapporteur : Umaid Singh** |
| **Co-chairperson** | **: M.H. Mengesha** | |
| 0830 - 0900 | Welcome | Y.L. Nene<br>J.I. Cubero |
| 0900 - 0910 | Objectives of the meeting | R. Jambunathan |
| 0910 - 0925 | Inaugural address | L.D. Swindale |
| 0925 - 1005 | Keynote address | J.H. Hulse |
| 1005 - 1030 | **Tea** | |

## SESSION II - Chickpea

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|---|---|---|
| **Chairperson** | **: M.A. Abd-Allah** | **Rapporteur : N.P. Saxena** |
| **Co-chairperson** | **: Laxman Singh** | |
| 1030 - 1050 | Production aspects and prospects of chickpea | H.A. van Rheenen |
| 1050 - 1055 | Discussion | |
| 1055 - 1115 | Legume consumption and its implication on nutritional status of population in India | N. Pralhad Rao and J. Gowrinath Sastry |
| 1115 - 1120 | Discussion | |
| 1120 - 1140 | Utilization of chickpea in India and scope for novel and alternative uses | P. Geervani |
| 1140 - 1145 | Discussion | |
| 1145 - 1205 | Factors affecting quality in chickpea | P.C. Williams, K.B. Singh, and M.C. Saxena |
| 1205 - 1210 | Discussion | |
| 1210 - 1230 | Utilization of chickpea in West Asia and North Africa | M.C. Saxena, K.B. Singh, and P.C. Williams |
| 1230 - 1235 | Discussion | |
| 1235 - 1255 | Chickpea utilization in Turkey | H.H. Gecit |
| 1255 - 1300 | Discussion | |
| 1300 - 1400 | **Lunch** | |

## SESSION II - Chickpea (Continued)

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|---|---|---|
| **Chairperson** | **: W.B. Wijeratne** | **Rapporteur : V. Ramanatha Rao** |
| **Co-chairperson** | **: R. Jambunathan** | |
| 1400 - 1420 | Uses and possibilities of chickpea in Spain | M.T. Moreno and J.I. Cubero |
| 1420 - 1425 | Discussion | |
| 1425 - 1445 | Utilization of chickpea and groundnut in Egypt; some popular dishes | M.A. Abd-Allah, Y.H. Foda, S.R. Morcos, and H.Z.A. Hassona |
| 1445 - 1450 | Discussion | |
| 1450 - 1510 | Uses of chickpea, lentil, and faba bean in Ethiopia | S. Yetneberk |
| 1510 - 1515 | Discussion | |
| 1515 - 1535 | Utilization of some important leguminous seeds in the Sudan | A. Elmubarak Ali |
| 1535 - 1540 | Discussion | |
| 1540 - 1610 | **Tea** | |
| 1610 - 1630 | Utilization of chickpea and groundnut in Pakistan | M. Akmal Khan |
| 1630 - 1635 | Discussion | |
| 1635 - 1655 | Uses of chickpea in Bangladesh | A. Ahad Miah |
| 1655 - 1700 | Discussion | |
| 1700 - 1800 | **General discussion** | **Leader : P.C. Williams**<br>**Rapporteur : S. Sivaramakrishnan** |

**Tuesday, 28 March 1989**

## SESSION III - Pigeonpea

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|---|---|---|
| **Chairperson** | **: Tipvanna Ngarmsak** | **Rapporteur : K.B. Saxena** |
| **Co-chairperson** | **: S.N. Nigam** | |
| 0830 - 0850 | Production aspects of pigeonpea and future prospects | Laxman Singh |
| 0850 - 0855 | Discussion | |
| 0855 - 0915 | Role of pigeonpea in human nutrition | Umaid Singh |
| 0915 - 0920 | Discussion | |
| 0920 - 0940 | Utilization of pigeonpea in India and scope for novel and alternative uses | M.P. Vaidehi |

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| 0940 - 0945 | Discussion | |
| 0945 - 1005 | Utilization of pigeonpea and other grain legumes in Indonesia | D.S. Damardjati and S. Widowati |
| 1005 - 1010 | Discussion | |
| 1010 - 1030 | Composition and quality of tempe prepared from pigeonpea seeds, and pigeonpea seed/soybean mixtures | K.A. Buckle and D.H. Iskandar |
| 1030 - 1035 | Discussion | |
| 1035 - 1120 | **Tea** | |
| 1120 - 1140 | Potential of pigeonpea as split dhal in the West Indies | S.C. Birla |
| 1140 - 1145 | Discussion | |
| 1145 - 1205 | Pigeonpea as a protein source in poultry diets | B. Cheva-Isarakul and Suchon Tangtaweewipat |
| 1205 - 1210 | Discussion | |
| 1210 - 1230 | Legume quality factors affecting processing and utilization | Manel I. Gomez |
| 1230 - 1235 | Discussion | |
| 1235 - 1255 | Grain legume protein - chemistry and utilization | S.O. Yanagi and K. Saio |
| 1255 - 1300 | Discussion | |
| 1300 - 1400 | **Lunch** | |

## SESSION III - Pigeonpea (Continued)

**Chairperson : D.S. Damardjati** **Rapporteur : C.L.L. Gowda**
**Co-chairperson : D.G. Faris**

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|---|---|---|
| 1400 - 1420 | Processing and utilization of soybean, and diversification of end-uses through extrusion processing | W.B. Wijeratne and A.I. Nelson |
| 1420 - 1425 | Discussion | |
| 1425 - 1445 | Development of cowpea products for utilization in the villages of North Eastern Thailand | Tipvanna Ngarmsak |
| 1445 - 1450 | Discussion | |
| 1450 - 1510 | Processing and utilization of legumes with particular reference to mungbean in the Philippines | R.R. del Rosario |
| 1510 - 1515 | Discussion | |

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|---|---|---|
| 1515 - 1535 | The composition, biological activity, and utilization of faba beans (*Vicia faba*) in human nutrition | L.A. Hussein |
| 1535 - 1540 | Discussion | |
| 1540 - 1610 | **Group photograph and tea** | |
| 1610 - 1630 | Institutional possibilities and implications of research on utilization | J.W.T. Bottema |
| 1630 - 1635 | Discussion | |
| 1635 - 1655 | | E.J. Weber |
| 1655 - 1700 | Discussion | |
| 1700 - 1800 | **General discussion** | **Leader : K.A. Buckle**<br>**Rapporteur : Umaid Singh** |
| 1830 - 2030 | **Cocktails and Dinner**<br>**204 Dining Hall** | |

**Wednesday, 29 March**

## SESSION IV - Groundnut

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|---|---|---|
| **Chairperson** | **: J.I. Cubero** | **Rapporteur : S.L. Dwivedi** |
| **Co-chairperson** | **: H.A. van Rheenen** | |
| 0830 - 0850 | Production aspects of groundnut and future prospects | S.N. Nigam |
| 0850 - 0855 | Discussion | |
| 0855 - 0915 | Groundnut quality characteristics | R. Jambunathan |
| 0915 - 0920 | Discussion | |
| 0920 - 0940 | Utilization of groundnut in India and scope for novel and alternative uses | S.S. Kadam and J.K. Chavan |
| 0940 - 0945 | Discussion | |
| 0945 - 1005 | Groundnut quality requirement for export market - present status, constraints, and future needs in India | G. Chandrashekhar |
| 1005 - 1010 | Discussion | |
| 1010 - 1030 | Cereal based foods using groundnut and other legumes | Bharat Singh |
| 1030 - 1035 | Discussion | |
| 1035 - 1055 | **Tea** | |

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|---|---|---|
| 1055 - 1115 | Traditional and potential uses of chickpea, pigeonpea, and groundnut in Burma | U. Kyaw Shin |
| 1115 - 1120 | Discussion | |
| 1120 - 1140 | Traditional and potential uses of chickpea, pigeonpea, and groundnut in Nepal | Tika Karki |
| 1140 - 1145 | Discussion | |
| 1145 - 1205 | Asian Grain Legumes Network activities | D.G. Faris and C.L.L. Gowda |
| 1205 - 1210 | Discussion | |
| 1210 - 1300 | **General discussion** | **Leader : Bharat Singh**<br>**Rapporteur : Manel I. Gomez** |
| 1300 - 1400 | **Lunch** | |

**SESSION V - Group Discussion and Preparation of Recommendations**

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|---|---|---|
| 1400 - 1420 | Slide Show - ICRISAT at a glance | |
| 1420 - 1540 | **Group discussion** | |
| | Chickpea : Group Leader | - P.C. Williams |
| | Rapporteurs | - S. Sivaramakrishnan, N.P. Saxena |
| | Pigeonpea : Group Leader | - K.A. Buckle |
| | Rapporteurs | - Umaid Singh, K.B. Saxena |
| | Groundnut : Group Leader | - Bharat Singh |
| | Rapporteurs | - Manel I. Gomez, S.L. Dwivedi |
| 1540 - 1610 | **Tea** | |
| 1610 - 1800 | Group discussion (continued) | |

**Thursday, 30 March**

**SESSION VI - Plenary Session**

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|---|---|---|
| **Chairperson** | **: Y.L. Nene**<br>**Deputy Director General (Acting) and Director, Legumes Program** | **Rapporteur : R. Jambunathan** |
| **Co-chairperson** | **: J.H. Hulse** | |
| 0930 - 0945 | Presentation by chickpea group leader | |
| 0945 - 1000 | Presentation by pigeonpea group leader | |
| 1000 - 1015 | Presentation by groundnut group leader | |
| 1015 - 1115 | General discussion and recommendations | |

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| 1115 - 1200 | **Tea** | |
| 1200 - 1215 | **Summary** | **R. Jambunathan** |
| 1215 - 1230 | **Closing remarks** | **Y.L. Nene** |
| 1230 - 1240 | **Vote of thanks** | **R. Jambunathan** |
| 1240 - 1400 | **Lunch** | |
| 1400 - 2000 | **City tour** | |

# Production Aspects and Prospects of Chickpea

H.A. van Rheenen

Principal Plant Breeder,
International Crops Research Institute for the
Semi-Arid Tropics
(ICRISAT), Patancheru, 502 324, Andhra Pradesh, India.

Chickpea has been cultivated for more than 7000 years. Its crop history and uses are discussed. It is a self-pollinating pulse crop with specific agronomic and crop protection requirements, which are briefly described, together with crop improvement aspects. The total area under chickpea and total production have shown little change over the last 20 years. Chickpea is a cool-season sub-tropical legume often grown on residual moisture. This imposes certain restrictions on its agroclimatic adaptation. Production can expand considerably if certain conditions are met.

# Factors Affecting Quality in Chickpea

P.C. Williams, K.B. Singh, and M.C. Saxena

Head, Analytical Methods Development Section,
Canadian Grain Commission, Grain Research Laboratory,
Agriculture Canada, 1404-303, Main Street,
Winnipeg, Manitoba R3C 3G8, Canada,
and Principal Chickpea Breeder and Leader,
Food Legume Improvement Program,
International Center for Agricultural Research in the
Dry areas (ICARDA),
P O Box 5466, Aleppo, Syria.

Uses of chickpea are summarized together with the main physical and chemical factors associated with chickpea utilization in primary and secondary processing. The influence of variability of these parameters on end-product utilization is discussed with particular reference to seed characteristics, protein content, and cooking time. The most important factors causing variability are location and season of production, cultivation practices, moisture status, and temperature during the maturation period. These are analyzed in relation to heritability.

Possible areas for future research on chickpea quality are discussed. These include a) size, shape, and texture of seed in relation to primary processing; b) physicochemical characteristics of chickpea flour and starch, including pasting properties, in relation to food acceptability; c) improvement of market potential of chickpea by development of snack foods; d) development of meat substitutes; e)

utilization of byproducts of primary processing; f) preparation of industry-useful components, such as chickpea fiber; g) determination of heritability of characters, such as protein and lysine content, with the objective of developing improved lines by selection; h) comparative studies of chickpea with other pulses, for production of popular pulse-based foods, and the reasons underlying preferences; i) upgrading of technology of chickpea processing to industrial status; and j) studies on the economics of the above aspects.

# Utilization of Chickpea in India and Scope for Novel and Alternative Uses

P. Geervani

Dean, College of Home Science,
Andhra Pradesh Agricultural University,
Rajendranagar, Hyderabad, 500 030, India.

Among the legumes consumed in India, chickpea is the most versatile, being used for main meals, savory snacks, and sweets. This is chiefly due to its flavor. Chickpea flour is fine and cooks quickly. Technology for developing ready-to-eat foods, biscuits, cookies, fermented foods, and soup-mixes using chickpea flour could provide alternative uses for chickpea.

Puffing is a well-accepted process for chickpea, but simple and easy-to-operate puffing units need to be developed. Ready-to-use roti flour mixtures, made by combining different millet flours with chickpea flour of good storage quality, would contribute significantly to balancing diets in areas where millets are staple foods. The effects of different crop species on chickpea protein utilization should be investigated. Less digestible starch formation in different varieties of chickpea during processing is another area for research. The therapeutic value of chickpea, in its hypoglycemic and hypocholesteremic effects, is of interest from the nutritional point of view. Data on trends in

consumption are needed for planning future research. As green chickpea seeds cook in less time and have higher amounts of B vitamins than dried or processed chickpea, the characteristics of vegetable chickpeas regarding nutrient composition should receive attention. Areas related to consumption and utilization need collaborative efforts on the part of research institutes and home science faculties.

# Legume Consumption and its Implication on Nutritional Status of Population in India

N. Pralhad Rao and J. Gowrinath Sastry

Deputy Director and Assistant Director,
National Institute of Nutrition,
Indian Council of Medical Research,
Jamai Osmania, Hyderabad, 500 007, India.

Food legumes, though second to cereals in terms of production and consumption, play an important role in the crop production system and in human nutrition. They form an important component of the diets of people in many developing countries of Asia and Africa. Food consumption trends of recent years in India indicate an increase in consumption of cereals, but the overall average daily per capita consumption level of pulses remained almost static, around 30 g.

These consumption trends reflect the production pattern of cereals and pulses obtained during the past 20 years in the country. Agricultural statistics indicate that pulse production has been either stagnant or declining during the seventies and early eighties, while cereal production has registered a dramatic increase.

Notwithstanding the nutritional benefits that pulses confer on an otherwise predominantly cereal-based diet, and also the agronomic advantages that legume crops lend to the production system, their output as well consumption levels

have not improved. Nutrition experts recommend that the ratio of cereal to pulse in the diet should be around 11:1 if the diet is to be balanced in terms of protein quality. Food consumption data obtained from about 20,000 rural and 8,000 urban households from ten states in India indicated that pulse consumption not only shows a clearcut socio-economic gradient but also exhibits a distorted pattern in relation to cereal consumption. This distortion becomes serious under scarcity conditions, as during the drought of 1987.

# Utilization of Chickpea in West Asia and North Africa

M.C. Saxena, K.B. Singh and P.C. Williams

Leader and Principal Chickpea Breeder,
Food Legume Improvement Program,
International Center for Agricultural Research in the
Dry Areas (ICARDA),
P O Box 5466, Aleppo, Syria,
and Head, Analytical Methods Development Section,
Canadian Grain Commission, Grain Research Laboratory,
Agriculture Canada, 1404-303, Main Street,
Winnipeg, Manitoba R3C 3G8, Canada.

Most of the chickpea grown and consumed in the Mediterranean region of West Asia is of the kabuli type. Foods are prepared mainly from whole seeds. Their preparation involves soaking, boiling, mashing, frying, roasting, and some dehulling. A small proportion is consumed as green seeds, or ground into flour and used in making a wide range of snack foods and sweets. The methods of preparation of the main foods are summarized. Quality factors important in food preparation from kabuli chickpea include seed size and protein content. Large seeds are preferred for most purposes. Protein and moisture contents of foods vary widely depending on the form in which they are eaten.

# Chickpea Utilization in Turkey

H.H. Gecit

Faculty of Agriculture,
Department of Field Crops,
University of Ankara,
Ankara, Turkey.

In Turkey, chickpea is sown over 665,000 ha (3.8% of total sowing area) with an annual production of 725,000 tonnes (37.2% of total edible legumes production). In recent years, chickpea has been grown in rotation as a dryland crop on fallow areas. Chickpea is also sometimes used as a green manure.

In Turkey, mainly light-colored chickpea is cultivated. The protein-rich grain is used in soups, in appetizers, either roasted, or as green grain, as homos in baby food, in desserts, and as a flour fermented with yeast.

In addition, chickpea starch is used in making plywood, while acids from its leaves are used in medicine. Ground seed coats and green or dry stems, and leaves are used as animal feed. If it can be grown economically, the whole crop can also be used as animal feed.

# Uses and Possibilities of Chickpea in Spain

M.T. Moreno and J.I. Cubero

Leader, Food Legume Unit,
Centre for Agriculture, Research and Development,
Universidad de Cordoba, Cordoba, Spain,
and Professor of Genetics and Plant Breeding,
Dept de Genetica Escuela Tecnica,
Superior de Ingenieros Agronomos,
Apartado 3048, 14080 Cordoba, Spain.

Chickpea in Spain is used both as human food and animal feed. Cultivars having white seed coat are used for human consumption. During the last 20 years, the use of chickpea for animal feed has decreased, and almost disappeared. On the other hand, chickpea is nowadays not just a source of protein for the poor, but also a basic component of several typical dishes. Therefore, the best chickpea types can command a very high price in the market.

The introduction of winter chickpea technology is again making it possible to use chickpea for animal feed. High yielding cultivars not suitable for human consumption can be suitable for this purpose.

Resistance to ascochyta, winter conditions, fusarium and other root parasites, and drought are urgent areas that require research. Chickpea seed has a high biological value, but studies on protein quality and technological characteristics are also required to provide adequate utilization in animal feed. These are also the most appropriate areas for collaborative research.

# Utilization of Chickpea and Groundnut in Egypt: Some Popular Dishes

M.A. Abd-Allah, Y.H. Foda, S.R. Morcos and H.Z.A. Hassona

Professor of Food Chemistry, Ain Shams University,
Faculty of Agriculture, Food Science Department,
Shoubra El-Khaima, Cairo, Egypt,

and

Popular dishes are those that are prepared and consumed by large sections of the population from various socioeconomic backgrounds. Not all popular dishes are nutritionally adequate. Ten Egyptian dishes were analyzed for their contents of carbohydrates, amino acids, fat, protein, fiber, ash, calcium, phosphorus, and iron. Chickpea and groundnut were added to raise the protein efficiency ratio, net protein utilization, digestibility, and chemical score of three of the dishes.

# Uses of Chickpea, Lentil, and Faba Bean in Ethiopia

Senayit Yetneberk

Food Scientist, Institute of Agricultural Research,
Food Science Research Division, Nazret Research Center,
P.O. Box 103, Nazret, Ethiopia.

The most widely cultivated food legumes in the Ethiopian farming systems are chickpea, lentil, faba bean, and field pea. These food legumes serve as important protein supplements in the cereal-based diets of Ethiopians. The consumption rate increases during fasting days (approximately 140 days per year) when Orthodox Christians abstain from meat. There are numerous dishes prepared from these pulses. Several procedures such as boiling, roasting, fermenting, sprouting, dehulling, and milling are used in traditional food preparations. The uses of husks, vines, and other parts of the plants are mentioned. Consumer preference of seed quality for ease of processing is also indicated.

# Utilization of Some Important Leguminous Seeds in the Sudan

A. Elmubarak Ali

Research Professor and Deputy Director,
Food Research Center, P O Box 213, Khartoum North, Sudan.

Groundnut, broad bean (Vicia faba), dry bean (Phaseolus vulgaris), lentil (Lens esculenta) and chickpea are the most important food legumes consumed daily in the Sudan in one way or another by a large part of the population. The most popular dishes are stews, curry, flafal and soups. Since local production of these legumes cannot meet demand, the country imports large quantities annually. Prices are unstable and vary over time. So far no food legumes industry exists, except for groundnut, which is used in different ways, roasted, salted, or as paste, or cake, or for fortification of other foods and confectionary, and for oil extraction. As most methods used in preparation of food legumes dishes are time consuming and expensive, especially with regard to fuel consumption, research is required in the fields of production and utilization. The present trend to produce cheap protein-rich foods will stimulate further investigation into food formulation and recipes containing leguminous seeds, especially for breads, biscuits, weaning food, and confectionary. The food legumes industry should be fully supported as a means of promoting such crops. Research should concentrate also on controlling various undesirable aspects, such as antinutritional factors, or those causing flatulence and poor cooking quality.

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# Utilization of Chickpea and Groundnut in Pakistan

M. Akmal Khan

Chief Scientific Officer,
National Agricultural Research Centre,
Food Technology and Nutrition Laboratories,
Islamabad, Pakistan.

Food legumes are important and economical sources of protein and other nutrients in diets in Pakistan. The total production of chickpea is 372,000 tonnes and that of groundnut is 52,000 tonnes in Pakistan, and the annual per capita availability is 3.04 kg of chickpea, and 0.45 kg of groundnut. Chickpea is processed and used in many forms, as fresh green seed, dried whole seed, dhal (decorticated dry split cotyledons), and flour, whereas groundnut is mainly consumed as whole kernel. The nutritive value of chickpea-based products, prepared from desi and kabuli types, and of groundnut are discussed.

# Production Aspects of Pigeonpea and Future Prospects

Laxman Singh

Principal Plant Breeder,
International Crops Research Institute for the
Semi-Arid Tropics (ICRISAT),
Patancheru, 502 324, Andhra Pradesh, India.

The current production of pigeonpea in the semi-arid tropics is principally confined to the Indian subcontinent (particularly India and Burma), Eastern and Southern Africa, and the Caribbean. Recently, commercial production has been catalyzed in Australia. Except in Australia, the cultivation of pigeonpea is practiced by small farmers to meet domestic needs of food (dry grain, split dhal and green vegetable), and of animal feed and fuel wood; and to produce a marketable surplus for cash income, and to form an important component of inter-mixed cropping with cereal-based production systems for sustainability, and risk aversion. This production is constrained by the cultivation practice of a minor component in an otherwise fast-growing sorghum, maize, or pearl millet crop, less productive land-resource allocation, excess water or drought stress peculiar to rainfed agriculture, and losses caused by diseases and pests, and long-duration landraces of 160-250 days. Other problems are inadequate support for technology generation and its transfer for stress-resistant, high-yielding genotypes, agronomic management, and new production systems, and lack of utilization research and

promotion, both of processed and raw material, for human and animal consumption.

The future prospects for enhanced and sustained production are bright, in that new short-duration cultivars (90-130 days) make pigeonpea amenable to field-scale cultivation as a sole crop in several production systems involving multiple cropping, both under rainfed and irrigated farming systems. New genotypes in the long-duration group are available with stable resistances to major diseases (fusarium wilt and sterility mosaic disease), which will contribute to the improvement of the traditional intercropping or mixed cropping production system of annual crops, as well as of a short-lived perennial in alley and agroforestry systems. However, instability of production under rainfed conditions, caused by excess and reduced rainfall, diseases and pests still remains a major issue for research in the short-duration group of cultivars. The potential for extension of area to new niches of production systems using short-duration cultivars can be realized with simultaneous research and development of raw and processed material for human and livestock consumption. A quantum jump in productivity may be achieved through using hybrid pigeonpea, new dwarf plant types, biotechnology techniques for introgressing incompatable wild species for germplasm development, and new sources of tolerances to abiotic stresses (drought and salinity), and biotic stresses (insect pests and diseases).

# Role of Pigeonpea in Human Nutrition

Umaid Singh

Biochemist,
International Crops Research Institute for the
Semi-Arid Tropics (ICRISAT),
Patancheru, 502 324, Andhra Pradesh, India.

A source of dietary protein, pigeonpea is used in various human foods in several developing countries, particularly in India. Like other food crops, the nutritional potential of pigeonpea as a human food is primarily determined by its chemical composition, bioavailability of nutrients, and the levels of various antinutritional factors. Proteins and carbohydrates are the principal constituents of pigeonpea seeds, and a variety of factors influence the nutritive value of these constituents. At ICRISAT, high protein lines of pigeonpea are available, and these lines are nutritionally better than the commonly grown cultivars. Pigeonpea seed contains noticeable amounts of antinutritional factors, such as protease inhibitors, oligosaccharides and polyphenols, but these constituents are wholly or partly removed by suitable processing methods. Globulins, which are deficient in sulphur amino acids, methionine, and cystine constitute nearly 65% of the total seed proteins of pigeonpea, and hence play an important role in determining the protein quality of pigeonpea.

India accounts for about 85% of the total pigeonpea production in the World, and for human consumption a large proportion of it is dehulled to convert whole seed into dhal, decorticated, dry split cotyledons. From a nutritional point of view, quantitative and qualitative losses occur during dehulling of pigeonpea. Cooking of dhal and whole seed affects the palatability and bioavailability of nutrients. Various physicochemical characteristics and environmental factors affect the cooking quality of pigeonpea. Traditional processing practices used to convert pigeonpea into consumable forms include soaking, fermentation, boiling, roasting, frying, and steaming, and these practices influence the nutritive value of pigeonpea.

Developing green seeds of pigeonpea are consumed as a vegetable. The nutritional composition of green seed is better than that of the mature seed, as the former shows higher protein and starch digestibility, and contains lower amounts of protease inhibitors, polyphenols, and flatulence causing sugars, raffinose, stachyose and verbascose.

Present status and future research and development needs in the area of nutritional quality of pigeonpea are highlighted.

# Utilization of Pigeonpea in India and Scope for Novel and Alternative Uses

M.P. Vaidehi

Associate Professor and Head,
Department of Rural Home Science,
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Indian vegetarian diets invariably include pulses. Barring very few desserts and snacks, most of these legumes are used in curried dishes, sambars, and side dishes. Green immature pigeonpeas are a delicacy and much preferred in roasted, boiled, and seasoned sundal forms, in soups, and in stews with vegetables. However, no effort has been made to establish a commercially viable green pigeonpea industry in India. Freshly sprouted pigeonpeas and germinated and malted flours are yet to become acceptable products. Flatulence is one of the key reasons why pulse-based dishes are avoided. Fermented, steamed products such as dhokla, tempeh, adai, and kadabu eliminate this problem. Pigeonpea mixed 40:60 with cereal and eaten with leafy vegetables is recommended for its nutritional value. Pigeonpea has a long shelf-life, but loses protein quality, thiamine, and niacin when infestation occurs. Dark testa varieties have more polyphenolic compounds and tannins in the seed coat. The addition of polyvinylpyrrolidone reduces enzyme inhibitory action. Dehulling results in the loss of the proteinaceous cotyledon

layer. Composite, ready-to-prepare enriched and germinated flours for weaning foods, extrusion cooking, and baking purposes are possibilities for future pigeonpea uses. Varieties with less solid dispersability should be used in desserts and snacks, unlike those of high viscosity preferred in curried dishes. Pigeonpea fractions, such as pure starch for noodles, and protein concentrates for dietetic products, have recently been suggested as novel uses. Pigeonpeas' flavor, followed by texture and color determine consumer preference.

# Utilization of Pigeonpea and Other Grain Legumes in Indonesia

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Research on utilization of pigeonpea in Indonesia was started in 1984 by the Agency of Agricultural Research and Development. A survey found that pigeonpea has been traditionally grown by farmers, especially in Java, Bali, Madura, and the eastern islands. The use of pigeonpea, however, was still limited. While traditional dishes, such as bongko, brubus, pecock hiris, were prepared domestically, a major limitation to increased use of pigeonpea in Indonesia was the lack of knowledge about the various methods of processing and utilizing the products.

An evaluation of the physicochemical properties was carried out for exotic genotypes and local varieties. Size, shape, color, mass, and bulk density were measured. Protein, fat, crude fiber, and moisture content were determined. Raw and boiled forms were tested for biological quality, i.e., true digestibility, biological value, and net protein utilization.

Research on processing and utilization of pigeonpea includes improvement of existing pigeonpea food products, such as soy-pigeonpea tempeh, and pigeonpea sauce; the development of new products, such as rice-pigeonpea cookies, and extrusion products; and the development of pigeonpea flour.

The future research and development program on utilization of pigeonpea will be focused on the nutritional evaluation of fermented and processed products, the development of new products, and the introduction and "scale up" of pigeonpea processing at the farm and home-industry level, and the evaluation of the processing efficiency, economic feasibility, and acceptability of the products.

# Composition and Quality of Tempe Prepared from Pigeonpea Seed, and Pigeonpea Seed/Soybean Mixtures

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Five varieties of pigeonpea (702, Hunt, Quantum, QPL 992, and B15B) grown in Australia, were analyzed for moisture, protein, individual amino acids, fat, crude fiber, ash, and carbohydrates content. The protein content varied from 22.0 to 26.0% (dry weight basis) with the Hunt variety containing the highest level. Analyses were also conducted on seeds that were soaked in water for 24 h, or soaked for 24 h and then dehulled, or soaked for 24 h, boiled 5 min, and dehulled; and on seed coats removed from seeds after soaking, and after soaking and boiling.

Tempe was prepared from pigeonpea seeds tempe gude, or soybeans tempe kedele, and from mixtures, (1:3, 1:1, and 3:1 w/w) of pigeonpea seeds and soybeans by soaking the seeds overnight in water, dehulling, boiling, cooking, and fermenting for 24-48 h at 30°C with the mould Rhizopus oligosporus strain $CT_{11}K_2$. Tempe samples were analyzed before and after frying for proximate composition, amino acids, Hunterlab color values, and non-enzymic browning. Tempe gude was considerably darker than tempe kedele, but

tempe prepared from a 1:1 mixture of pigeonpea seeds and soybeans was acceptable in color and other characteristics to Indonesian consumers.

Future work will examine the biochemical and chemical changes in the seeds during the soaking process before fungal fermentation; the factors responsible for the unacceptable color of tempe gude; the quality of tempe prepared from mixtures of pigeonpea seeds and other grains and legumes; and the incorporation of pigeonpea seeds and flour in other traditional fermented and non-fermented foods.

# Potential of Pigeonpea as Split Dhal in the West Indies

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Pigeonpea has been grown in the West Indies for a long time, as a vegetable, and as a grain legume. However, production has remained stagnant due to inadequate processing and marketing arrangements. The potential of the crop in the dry split form is yet to be tapped. The value of imports of dry peas and beans in the region, on an average, during the years 1981-86 was US $ 12.5 million per year. Trinidad and Tobago alone accounted for 58% of all regional imports. Split peas (Pisum sativum) forms a substantial part of the imports (more than 80%), for use as dhal, since it cannot be grown locally. However, dry pigeonpea after processing into dhal can be used as a replacement for split peas.

This paper attempts to evaluate the potential of pigeonpea as dhal in the West Indies. The present status of the pigeonpea industry in the West Indies is described, based on an analysis of the trends of production, acreages, and yields in different countries of the West Indies. Current uses of pigeonpea are also discussed. The potential for processing of dry pigeonpea for dhal is established by determining the demand based on current consumption patterns

and other economic indicators, such as population growth and income projections.

The economics of processing of pigeonpea has been worked out, and sensitivity analysis used to determine its profitability. Factors affecting the realization of the potential are examined, including socioeconomic and institutional factors, and government policies. Arising from the foregoing, ways and means to realize the potential are discussed. Areas for further research are identified, and cooperation between regional and international agencies is emphasized.

# Pigeonpea as a Protein Source in Poultry Diets

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The effect of using feeds with high contents of pigeonpea (30-50%), supplemented with methionine on performance, pancreas mass, haematocrit, and mortality rate was studied on 270 heads of 7-day old broilers.

After 7-day pellet feeding, prior to the experiment, the birds were randomly allocated to 10 treatments, each with 3 replications. Feed and drinking water were freely accessible. The rations contained 2900-3000 kcal $kg^{-1}$ with 21, 19, and 17% crude protein for birds 1-3, 3-6, and 6-7 weeks old respectively. The levels of pigeonpea were 30, 40, and 50%, and methionine at 50, 100, and 150% was added above the suggested requirement. The treatments were compared with the control of 0% pigeonpea, and 50% methionine above the requirement.

No significant mass gain differences were found among the groups at week 7, ranging from 2.0 to 2.2 kg. The feed consumption and feed conversion ratio increased according to the increasing level of pigeonpea used. The same was found for pancreas mass, while the haematocrit value was not affected. Methionine supplement at the level of 100 and 150% above the suggested level could not improve the performance of the birds fed on high levels of pigeonpea.

# Legume Quality Factors Affecting Processing and Utilization

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Much of plant breeding work on the quality of legumes has been directed towards improving their nutritional quality, notably increasing protein content, and improving the amino-acid pattern, and the balance and reduction of anti-nutrient factors, such as trypsin - inhibitors and haemaglutinins. Relatively less attention has been paid to quality factors that affect the processing and utilization of legumes. This paper briefly reviews and highlights recent work on the processing quality of legumes in order to provide pointers to future objectives and strategies in legume improvement programs as they apply specifically to ICRISAT mandate crops.

Quality factors affecting cooking time and cookability are major determinants of utilization and processing potential. Some of these, such as water absorption, hydration, starch gelatinization, and the effect of processing treatments on these characteristics are reviewed. Postharvest and storage-quality changes in legumes, which cause the hard-to-cook phenomenon and the mechanisms involved, are discussed to illustrate the importance of good storage conditions.

Available processing technologies, such as germination, fermentation, and protein isolation/concentration, as well as newer applications of groundnut and chickpea in novel foods, such as beverages and pasta products, are examined in relation to grain and food quality requirements.

# Grain Legume Protein: Chemistry and Utilization

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Legumes can be roughly classified as rich sources of proteins, carbohydrates or oils. Groundnut is a rich source of oil, while pigeonpea, and chickpea are rich in carbohydrates and proteins, an important property of nitrogen-fixing legumes. Legume proteins are very diverse. Purified seed proteins from legumes were once grouped into legumin and vicilin types, but many legume storage proteins cannot be included in these two categories by ultracentrifugal and electrophoretical studies. Recent biotechnological research on legume proteins and DNAs with restriction enzymes and sequencing techniques have revealed details of similiarities and differences between legume proteins. However, under practical conditions proteins are not used in a purified form, but along with other substances. Fundamental and analytical studies have produced a partial explanation for the interactions of legume components and their role in legume utilization. Meanwhile, extending the traditional and new utilization methods of some legumes to other legumes seems to be a feasible proposition. There are many legume products, especially of soybean in Japan, which utilize their protein-rich properties. Examples of such products, and expanding applications of the processing mechanisms to other legumes, are also given.

flour. The concept offers potential to serve as a technology base for medium-scale processing of soybean on a decentralized basis. The technical aspects of dry extrusion, functionality of the potential products, and their applications in food systems are discussed.

The composition of a cereal/legume blend plays a vital role in the nutritional and functional characteristics of final products produced by extrusion. Development of specific products must be approached on a country-specific basis, with due regard to the local food habits and preferences. Chickpea, pigeonpea, and groundnut are rich sources of protein. However, they differ in the distribution of fat and carbohydrate contents. The potential for producing low-fat flour from groundnut and its combination with the other legumes to produce locally acceptable extruded products may be a interesting area of research. The use of soybean in combination with the mandate legumes will extend the available supply of the latter.

# Development of Cowpea Products for Utilization in the Villages of Northeastern Thailand

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Research on the utilization of cowpea in northeastern Thailand revealed that cowpea is not regarded as a domestic, household crop, except when grown and eaten as green vegetable. First, village households were taught how to cook cowpea dishes. They were also encouraged to grow cowpea for household consumption. A nutritionally balanced diet was designed using cowpea dishes, which were introduced into the diet of villages in northern Thailand. A study was undertaken of current food habits, and cowpea dishes and a 7-day menu were developed and introduced in the villages. Later, a mini dehuller and a pin-mill for village processing of cowpea flour were introduced, as well as a new method of cooking cowpea flour in households, and making snack foods from cowpea flour for sale by village food vendors. This was expected to encourage villagers to grow cowpea for processing in villages. A third stage was laboratory research for the industrial utilization of cowpea. The functional properties of cowpea flour, cowpea starch, and cowpea protein were studied. Some potentially commercial products were developed on a laboratory scale, tested, and found highly acceptable.

# Processing and Utilization of Legumes with Particular Reference to Mungbean in the Philippines

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A wide range of possibilities exist for utilizing legumes. The products may be classified as consumer products, which can be directly eaten, or as ingredient for food preparation.

Mungbean in the Philippines is traditionally used for making sotanghon or bean noodle, for mungbean sprouts, as filler for pastries, or as main vegetable ingredient in sauteed mungbean. The traditional process of mungbean noodle manufacture may be broken down into simpler processes to produce mungbean starch and mungbean protein in the dry form. Mungbean protein has considerable prospects as raw material for the manufacture of many protein products.

Whole mungbean is an ingredient for food production, as in canned sprouts or as raw material for flour preparation. The whole beans could also be processed into quick-cooking or instant mongo beans, or manufactured as a snack food. New technologies, such as extrusion of mungbean alone, or in combination with other raw material, could give products of improved nutritional value, ranging from baby food, and snack food to textured vegetable protein.

# The Composition, Biological Activity and Utilization of Faba Bean in Human Nutrition

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Faba bean (Vicia faba) is a winter crop and is grown in Egypt for consumption purposes. While 10% is consumed fresh, 90% is harvested dry during the month of June. The crude protein content of the local varieties varies from 27 to 29%, and is deficient in sulfur containing amino acids and isoleucine. Sucrose accounts for 25% of the total sugars. The fiber content is about 20% of the whole faba bean seed, but this is reduced significantly by cooking.

The presence of proanthocyanidins (PA, tannins) in the seed coat of some faba bean varieties poses a serious nutritional problem. Triple white (TW) is a cultivar with almost no PA in the seed coat. Processing of the faba beans into paste bessara, or cakes falafel involves removal of the seed coat. However, in the preparation of stewed faba beans the seed coat is not removed. PA was completely destroyed by putting faba beans in contact with ammonia vapor. The glycosidic pyrimidines, vicine, and covicine, are antinutrient factors present in the cotyledons of faba beans. Complete elimination of these factors can be successfully accomplished by soaking in 1% acetic acid.

Environmental factors, particularly locality and temperature, have an effect on the sucrose content and cooking time. Many physical and chemical attributes of the seed correlate significantly with cooking time.

When faba beans were fed to boys as a part of a mixed diet, variety TW was considered the best in terms of protein, amino acids, mineral digestibility, and biological value. Administration of methionine capsules with the diet improved digestibility of all essential amino acids. The protein quality of the ammonia-treated cooked faba beans was quite inferior. The group consuming faba bean with high PA content, excreted stools with higher levels of bile acid, trypsin, and amylase activities.

Consumption of different faba bean dishes by control and diabetic volunteers showed reduced blood glucose content, indicating the value of faba beans in the dietary management of diabetes.

The preparation of modified and unmodified faba bean proteins may find application in food technology on account of their unique characteristics.

# Production Aspects of Groundnut and Future Prospects

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Groundnut seeds are rich in oil (36-54%), and protein (21-36%), and have a high energy value of 564 Cal 100 $g^{-1}$ of seed. They are used for oil extraction, as food, and in confectionery products. The cake remaining after extraction is processed for animal feed and human consumption. The haulms are valued as fodder. Cultivated groundnut, a native of South America, is grown on 20 million hectares in about 80 countries, with a total production of 21.5 million tonnes. The approximate limits of present commercial production are between latitudes 40°N and 40°S. Groundnut is mostly grown in Asia followed by Africa, North and Central America, and South America. Groundnut crops are found in farms at all levels of development - from bush clearings to the highly mechanized high-input outfits of North Carolina and Georgia. The productivity varies accordingly - from 300 kg $ha^{-1}$ to 10 t $ha^{-1}$. The key to high yields is identifying and overcoming the constraints to production.

# Groundnut Quality Characteristics

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Groundnut quality is a broad term and includes the physical, chemical, and food quality of groundnut seed. Nearly 66% of the groundnut produced in the world is crushed for oil, which has wide applications. In India, which is the largest producer of groundnut, the most important use of groundnut is for its oil content. At ICRISAT, screening of germplasm accessions of groundnut has shown a large variation for protein and oil contents. Storage stability of oil is an important factor, especially in developing countries, where storage conditions are not ideal. The concentration of oleic and linoleic acids in groundnut oil affect the stability of oil to a large extent.

A variety of food uses of groundnut is known, and groundnut butter is one of the most popular products in several countries. Low-fat groundnut is also receiving increased attention for use by calorie-conscious consumers. Flavor components of groundnut are very important in determining the acceptability of groundnut products, and this is a complex area, relating objective measurement with subjective evaluation. Protein quality and functional

properties of isolated groundnut protein have been investigated extensively, and a number of efforts have been made from time to time in several countries to utilize groundnut protein ingredients for human food. Protein quality of groundnut is about 74% of casein quality.

Groundnut hull forms a sizeable proportion (about 25%) of the total production of groundnut. Various methods have been proposed to make use of the groundnut hulls, particularly as a supplement to cattle feed, and attempts have been made to improve the digestibility of the hulls.

# Utilization of Groundnut in India and Scope for Novel and Alternative Uses

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Groundnut is one of the important oilseed crops of India. More than 80% of the production is used for oil extraction by screw or expeller pressing. The cake obtained by this process contains 6 to 8% oil, and is mostly used as animal feed. A small proportion of groundnut production is used as roasted, salted, or fried nuts, or as meal in various recipes. After pigments and the residue oil are removed, cake meal can be substituted for 10% of wheat flour in bakery products, such as cookies. Groundnut milk to the extent of 20% can be substituted for whole cow's milk in the preparation of acceptable icecream. Groundut kernels or meal can be used for foods, such as groundnut butter, fermented products, composite flours, milk, and milk products, but technology based on consumer acceptance, and using varieties grown in India, needs to be developed for such products. Research is needed to improve the efficiency of the oil extraction process; to refine partially the oil to improve its quality and storage stability; to utilize cake as a source of protein in foods; to standardize the technology of roasted, salted nuts; and on the use of groundnut in the preparation of various unconventional products.

# Groundnut Quality Requirement for Export Market-- Present Status, Constraints and Future Needs in India

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As the largest producer of groundnut (estimated output in 1988-89 was over 7.5 million tonnes unshelled) India has undoubted potential to supply medium and small seeded varieties of groundnut, in shell and as kernels. Bombay bold, Java, JL 24, and G2 are varieties available in counts varying between 40/50 and 70/80 kernels per ounce, well suited to meet the requirements of a sizable section of discerning users around the globe.

Despite supply potential, Indian edible groundnut exports languished for a decade because of unsteady production and lack of Government support. Fortunately, through a welcome combination of a pragmatic Government attitude and large farm output, Indian groundnut export has just started to look up. Amongst Indian exporters there is now a rediscovered consciousness that they must meet the demands of exacting quality standards, tailor-made to suit specific requirements of individual buyers. However, sorting/grading facilities are inadequate, though there is scope for mechanization of various operations.

Production of processed groundnut, such as roasted/salted kernels and roasted in-shell, is low in volume, and exports are almost non-existent. Improvement in shelf-life of processed groundnut requires attention. There is need for propagation of virginia-type large-size groundnut. Recent liberalisation of seed import for cultivation is reportedly to overcome shortage of high-yielding seed varieties. Evolution of aflatoxin-resistant varieties will have far-reaching beneficial implications for India. Quality, including aflatoxin control, is another area that needs to be strengthened through education and adoption of appropriate postharvest practices.

# Cereal-Based Foods Using Groundnut and Other Legumes

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A review of studies conducted on application of flours or concentrates from groundnut, cowpea, and soybean to improve nutritional characteristics of wheat-based bread and cookies, corn-based uji and sorghum-based kisra are presented. Acceptable cookies were made from composites containing 50% wheat, 35% groundnut, and 15% black-eyed pea flours. At this level of fortification, the protein content was 151% over the wheat protein content. Acceptable breads using 70% wheat, 20% groundnut, and 10% black-eyed pea flour had 70% more protein compared to breads prepared with wheat alone. The composite flours had significantly higher amounts of protein, fat, fiber, and almost all minerals, and lower amounts of tannins compared to wheat flour. Cowpea flour and soy concentrate were used to improve the protein content of sorghum-based uji, a food commonly used in Tanzania. There was an increase of 40% protein content in the sorghum-cowpea combination (80% sorghum and 20% cowpea), and a 74% increase in sorghum-soy concentrate combination (80% sorghum and 20% soy concentrate). Kisra is a sorghum-based product, commonly used in the Sudan. Acceptable and nutritionally superior quality kisra was prepared from sorghum flour fortified with

defatted groundnut flour. Addition of defatted groundnut flour resulted in improvement of baking ease, color, and texture of the final product. The percentage increase in protein content at the 30% level of fortification varied from 53% to 122%. There were significant increases in all essential amino acids. Fortification with groundnut and subsequent fermentation improved the *in vitro* digestibility of the sorghum flour.

# Asian Grain-Legumes Network Activities

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The Asian Grain-Legumes Network (AGLN) is a research network whose members are scientists and research administrators in Asia, interested in coordinating their activities on groundnut, chickpea, and pigeonpea. Its major goal is to strengthen the capability of national programs in Asia to conduct research on these legumes, with an ultimate aim of increasing their production and consumption in Asia. Its members are drawn from national agricultural research systems (NARS), ICRISAT, other international and regional research institutes, and donor groups. The network activities include coordinated yield trials and nurseries, collaborative research, meetings, monitoring tours and workshops, training, exchange of ideas, information, technology and material, and distribution of literature.

The network has a coordination unit that is supported by ICRISAT and is part of the Legumes Program. The coordination unit has developed strong links between ICRISAT and the national programs of ten countries through formal memoranda of understanding and bilateral work plans. The

coordination unit facilitates direct contact between national and ICRISAT scientists, who carry out collaborative research and activities identified in the work plan. Contact among national program network members, in AGLN countries and in other regional institutes associated with the AGLN, comes from joint meetings, tours, and workshops sponsored by the AGLN.

The AGLN has always been interested in studying alternative uses of its crops, particularly pigeonpea in Indonesia and Thailand. The lead role in this work has been taken by the ACIAR, and the scientists and economists in these two countries, with input from CGPRT and ICRISAT. ICRISAT's future plans include giving more emphasis to the uses of its mandate crops. For this reason, there should be increased activity within the AGLN on developing new uses of groundnut, chickpea, and pigeonpea in Asian countries. The recommendations of this consultancy will influence the nature of these activities, and contacts made at this meeting can form the basis for starting new initiatives.

# Traditional and Potential Uses of Chickpea, Pigeonpea, and Groundnut in Nepal

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Legumes are a source of protein supply to the majority of the people in Nepal. Emphasis has been placed on increasing production of legumes, including chickpea and pigeonpea, and oilseeds, such as groundnut, for their contribution to Nepalese diets. Most of these legumes are consumed in the form of split pulse (dhal), as a soup or soup-like products; whereas the green leaves, pods, and tender seeds are eaten as a vegetable. Chickpea and groundnut are also roasted, deep fat-fried, and salted, and used as a snack. Groundnut is also roasted along with its shell, and consumed after peeling the shell. Chickpea and pigeonpea are sprouted and consumed in the form of vegetable soup. A mixture based on legumes and cereals has been developed as a weaning food. Recently, these legumes have been incorporated in wheat flour and developed into a noodle-like product with attractive color and taste. In SAARC countries, the use of legumes, cultured with microorganisms, has been limited to a few products (such as Idli, and Dosa of India). There is tremendous scope to utilize these leguminous crops for enhancing flavor and taste, and increasing B-vitamins by selected biotechnological processes that are already available in other South Asian

countries. Products like tempe of Indonesia, and kinema of Nepal, India, and Bhutan have to be carefully studied, and future collaborative research activities should be initiated in the region for developing products and recipes suitable to local taste. These process help not only to eliminate antinutritional factors inherent in the leguminous crops but also to increase the nutritional level of the products. Other viable collaborative research actitivies can be initiated in the area of developing extruded products from these legumes, to suit local taste, in consideration of the nutritive value of the products.

# Research on Commercial Utilization of Food Legumes

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In the last two decades, class differentiation in societies in Asia assumed recognizable characteristics. In most countries, middle classes have evolved, constituting sizable groups with buying power, and distinct consumption patterns. In general, the middle classes tend to consume less staple food and more luxury goods, including snack and processed foods. The development of the animal-feed sector is a major indicator of this social process, as is also the further development of the snack and process food industries. Demand for "industrial food crops" (soybean, maize, cassava, and perhaps grain legumes) has risen quite sharply. It is timely to analyze demand for specific market segments, supplied by various types of raw produce. Research on utilization aspects should follow the lines of a commercial project development rather than the methods for determining national food requirements in aggregate terms.

It has become clear over the last few years that budget allocations for national agricultural research systems remain geared to research for maintaining and expanding basic food stuffs. Although grain legumes vary in importance from country to country, in general they do not enjoy significant

budget support in Southeast Asia. Recognizing the limited resources allocated, the increasing institutional flexibility of conducting research on a project or a contract basis is recommended. A relatively high proportion of national research on food and grain legumes has been financed by international and bilateral sources, and lately in various countries private-sector companies have indicated an interest in securing stable supplies for processing, resulting in a need for contract research. Institutional focal points of a program would include bureaus of planning, and departments of agricultural business development.

# Uses of Chickpea in Bangladesh

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Chickpea is the third most important pulse crop of Bangladesh, in area and production. About 36,000 tonnes of grain are annually produced, of which 14% is retained for seed, and the rest is used in various forms in the daily diet of Bangladeshi people. It is mainly consumed as dehulled split grain, whole seed, or flour in the preparation of many savoury and sweet dishes. About 60-65% of chickpea is used as dhal, dehulled split cotyledon, which is cooked with hot spices, meat, eggs, or vegetables, and served as curry with a main course of rice and rotis. Sometimes, dhal is cooked with rice, as Khinchuri.

About 10-15% chickpea is consumed as whole grain, either boiled and cooked with spices, as boont birani, or roasted on hot sand, and eaten as such, or sold by hawkers mixed with small quantities of onion, green chilies, mustard oil, and salt. Kabuli chickpea is deep fried in oil, mixed with salt and chilli powder, and sold in bakery shops at a high price. A small quantity of desi chickpea is also consumed as sprouted seed, mixed with salt and lemon juice.

Another major use (15-20%) is in the form of flour called basan, which is mainly used for making hot snacks, such as pianjee, beguni, chanachur and papor, and sweets, such as bundia and halua. Sometimes, chickpea flour is mixed with wheat flour for making roti in some parts of Bangladesh. The flour made from the sand-roasted grain called chhatu is directly consumed by mixing it with jaggery (gur), and water.

Further research is needed to determine and improve the nutritional quality of some food stuffs, such as khinchuri, wheat and chickpea roti, sprouted chickpea and chhatu to popularize the use of chickpea as a substitute for animal protein in a balanced diet for human beings.

# Information for Participants

## Welcome to ICRISAT

We hope that you will find your stay comfortable. Please do not hesitate to contact any member of the Organizing Committee if you need any help.

## Accommodation

Arrangements have been made for your accommodation in the dormitories at ICRISAT Center. Please contact the Housing Office as soon as you arrive at ICRISAT Center.

## Food

Food will be served in the Dining Hall, Building 204 at the following times. The food coupon in your workshop bag is to be shown to the cashier at the food counter.

| | |
|---|---|
| Breakfast | 0645-0745 |
| Lunch | as per Program |
| Dinner | 1900-2000 |

During the evening (1700-2130) beer and soft drinks are on sale in the Trainees' Lounge (on the ground floor, adjacent to Snack Bar in Building 204).

## Registration

Registration will take place at the Conference Center, Building 212, from 0745 to 0830 on Monday, 27 March.

## Name badges

All participants are requested to wear their name badges throughout the meeting. ICRISAT staff will wear identity cards.

## Venue

Conference Center, Building 212. Microphones are arranged within your reach. Please do not switch them on until the Chairperson asks you to speak. Please identify yourself before asking a question or making a comment. For others' convenience, please refrain from smoking in the Conference Center.

## Slides for presentation

If you wish to support your presentation with 35 mm transparencies, please hand them in numbered order to a projectionist in the Conference Center during the session preceding the one in which you are scheduled to speak. Facilities for projecting overhead transparencies are also available.

## Finance

Incidental and en-route expenses will be paid on Tuesday 28 March during tea break. Participants are requested to sign and return the acknowledgment slip.

**Telex and Mail**

Participants who wish to use ICRISAT telex and mail facilities may do so by contacting T.R.K. Satyanarayana/T.S. Noel Prashanth.

**Return journey**

For reconfirmation or for any changes in your travel, you may please contact Biochemistry Program Administrative Officer, T.R.K. Satyanarayana at the reception counter/telephone no. 367.

**Proceedings**

The proceedings of this meeting will be published. If you are presenting a paper, you may be contacted by Dr Vithal Rajan the Proceedings Editor and/or by Dr R. Jambunathan the Scientific Editor about clarifications/questions during the course of the Workshop.

**ICRISAT Publications**

ICRISAT publications are on display in the Conference Center, Building 212. If you would like single copies of any of these, or any other publications listed in the ICRISAT catalog, please complete the form in your catalog and return it to the secretarial staff by afternoon tea break on 28 March. Publications will be available for collection on 30 March morning.

**Medical**

Dr N. Surya Prakash Rao, Sr. Resident Medical Officer, will be available for consultation in the Field Medical Unit (FMU) during working hours. After office hours, he may be contacted at his residence. His telephone numbers are: 638 (FMU), 113 (home).

**Recreation**

The swimming pool, tennis courts, table tennis room, football ground, and basketball court are all situated to the east of the building complex and close to the dormitories. You are welcome to use these recreational facilities before/after conference hours. There is an attendant at the swimming pool from 0800 to 1900. Table tennis bats and balls are available from the pool attendant.

**Mamta**

A handicrafts shop, run by ICRISAT Ladies' Association for the Welfare of Women and Children (ILAWWAC), is located on the ground floor in Building 204. The shop will be open at the following times:

Monday, Wednesday, and Friday: 1200 to 1400.

**Security**

As a routine procedure, all persons (including ICRISAT staff) entering or leaving ICRISAT Center may be stopped for a security check at the main gate. We request you to cooperate with the security staff at all times.

## Important Telephone Numbers

**ICRISAT City Office : 37709**

**ICRISAT Center : 224016**

For any outside call please dial 9 and ask for your number.

**Housing**

B.R. Revathi Rao*
Asst. Manager
Housing
541 (office), 191 (home)

**Food**

S. Mazumdar*
Asst. Manager
Food Services
547 (office), 180 (home)

**Medical**

N. Surya Prakash Rao*
Sr. Resident Medical Officer
638 (FMU), 113 (home)

**Transport**

K. Jagannadham
Transport Unit
456 (office)

**Travel**

A. Rama Murthy
Travel Officer
141 (office), 38160 (home)

**Biochemistry**

R. Jambunathan*
Program Leader
366 (office), 678 (home)

T.R.K. Satyanarayana
Program Administrative Officer
367 (office)

**Delhi Office**

K.K. Vij
23, Golf Links
New Delhi 110 003
615931 (office), 588206 (home)

EMERGENCY 192 (Security)

*Staff stationed at ICRISAT Center. Three digit telephone numbers are ICRISAT extension numbers.

# ICRISAT
# Housing and Food Services Guidelines

The Department of Housing and Food Services welcomes you and wishes to assure you that, as our guest, it is our intention to do all we can, to make your stay at ICRISAT as comfortable as possible. If we can be of any assistance, please contact the Housing Office, Tel. 550 between 0600 and 2200.

As in all institutions, we have guidelines that will assist you to adjust to your new surroundings. These include:

**The power supply on ICRISAT Campus is 220 volts.**

**Meals** - Can be obtained from our dining areas on payment of cash. Visitors/Guests who are on "Full Board" status will be issued with meal tickets which must be shown to the cashier when they receive the meal.

Meals will not be served in dormitory rooms, unless the occupant is ill and has orders from the Resident Medical Officer not to leave the room.

**The tap water in buildings on ICRISAT Campus is safe to drink.**

**Please note, cooking in the dormitory rooms/tea rooms is strictly prohibited, as is taking cutlery/crockery from the dining hall areas to dormitories.**

Meals are served at the following times:

**Dining Center Building 204**

Dining Hall (upstairs)

| | **Breakfast** | **Lunch** | **Dinner** |
|---|---|---|---|
| Saturday | 0645 to 0900 | 1200 to 1330 | 1900 to 2100 |
| Sunday | 0645 to 0900 | 1200 to 1330 | 1900 to 2030 |
| Other days | 0645 to 0745 | 1200 to 1330* | 1900 to 2000 |

***Important:** From May through November Lunch times for Inservice Trainees will be from 1130 to 1200.

Snack Bar (downstairs)

**Lunch** (Vegetarian) Monday through Saturday - 1200 to 1315.
**Evening Snacks/Tea** Monday through Friday - 1700 to 1830.

Trainees' Lounge
Open 1830 to 2130 every evening.

**Guest Rooms** - General cleaning including changing bed linen and towels will be done by Housekeeping. Linen will be changed twice a week, on Mondays and Thursdays. You are responsible for tidying your room each day, and for your room key, which if lost will be replaced at a cost to you of Rs.20.00; wardrobe/drawer keys will be replaced at Rs.10.00 per key. **In case you happen to leave your key in the room and lock the room please contact the Housing Office, Tel. 550 or Main Gate Security, Tel. 117.**

**Laundry** - Will be done by Housing and Food Services for dormitory residents free of cost on two days each week - Tuesdays and Fridays. Clothes given for laundering on Tuesdays will be returned on Fridays and those given on Friday will be returned the following Tuesday. Please fill out two laundry slips when sending laundry and keep one slip for your personal record. Soiled clothes together with a laundry slip should be put into a laundry bag available in the room and left inside the room before 1200. Laundered clothes will be delivered to your room between 1500 and 1700.

Pressing irons for personal use are available from the Housing Office on a 'check-out' basis.

**Cooling System** - The cooling system that operates from March to June in your room is by air blowers. There are no regulators or cut-off switches in individual rooms. Please keep the veranda door slightly open in order to relieve the air pressure that builds up in the room when the blowers are on, otherwise you may be bothered by a storm-like noise.

**Personal Items** - It is recommended that you have, and care for your own torch. **Please keep your belongings locked up.**

While necessary precautions will be taken to safeguard your personal belongings, ICRISAT will not be responsible for items lost from your room. Safe deposit lockers are available in the Housing Office.

**Finance** - It is recommended that all long-term occupants open a bank account in the State Bank of Hyderabad situated near the Housing Office. The minimum bank balance required without checkbook facility is Rs.20.00.

The banking hours are:

| | |
|---|---|
| Monday through Friday | 1130 to 1430 |
| Saturday | 1130 to 1300 |

The Housing staff can assist you in opening an account. Foreign currency can be exchanged at the State Bank of Hyderabad or ICRISAT Fiscal Division Cash Counter.

| | |
|---|---|
| Monday through Friday | 0830 to 1130 |
| | 1330 to 1530 |

**Lending Library** - There is a lending library of paperback novels situated in the Housing Office. This relies on books donated by visitors/staff/trainees.

**Mamta** - A shop for handicrafts, gift items, and post cards is located on the ground floor of the Dining Center in Building 204. It is open every Monday, Wednesday, and Friday from 1200 to 1400. **Mamta** is run by ICRISAT Ladies Association for the Welfare of Women and Children (ILAWWAC), a charitable organization within ICRISAT.

**Transport** - Arrangements for Trainees and ICRISAT families living on the campus to go to the city will be through the regular shuttle transport system operated by the Transport Department. Consult the schedule of transport to and from the city provided for campus residents on the dormitory notice board.

Taxi cabs, buses and auto (motorized) rickshaws are available for transport within the city.

**Recreation** - The Swimming Pool is open fom 0600 to 2200 15 March to 14 June, and 0700 to 1900 15 June to 14 March. A coach is on duty from 1030 to 1830 Wednesday through Saturday and from 0800 to 1600 on Sundays. Sports equipment (volleyball, basketball, badminton, table tennis, soccer, etc.) is available with the swimming pool attendant for your use and return. Tennis rackets/balls will not be provided. Please report when equipment repairs are required.

Video films will usually be shown on Friday and Sunday (English) and Thursday (Hindi) in the Auditorium, Building 202. See "ICRISAT Happenings" every week for details. Consult the daily newspapers for the many films, sport, and cultural activities in English and other languages available in the Hyderabad-Secunderabad community. Newspapers are available in the dormitory lounge area.

**Guests** - Visitors are permitted on the campus until 2200. All visitors must have an ICRISAT pass/identification. Entry of visitors is restricted to the dormitory lounges, Swimming Pool, Trainees' Lounge, and Cafeteria, **not inside the dormitory rooms**. Visitors should be accompanied at all times by the Dormitory/Flatlet occupants whom they are visiting.

Guests and visitors must register in advance with the Housing Office to stay in the Dormitories.

**Medical** - First-aid kits are available at the Housing Office and Swimming Pool. The Resident Medical Officer will be available for consultation at the Field Medical Unit (FMU), Tel. 638 during working hours. After office hours, in case of emergency, he can be contacted at his residence, Tel. 113.

**Cooperative Stores** - Toiletries, cigarettes, instant coffee, tea, sugar, etc., are available at the Cooperative Stores, situated next to the Swimming Pool.

Open: Monday through Friday—0900–1130 and 1215–1615; Saturday—0900–1200.

**Mail Service** - You should use the following mailing address:

(Your name)
Housing Office
ICRISAT
Patancheru
A.P. 502 324, INDIA

Your mail will be delivered to the Housing Office. Letters may be placed in the mail tray in the Housing Office, or Post Office drop box. The Post Office is situated in the old FDO building, near the Main Gate, Open - Monday through Saturday 0830 to 1100 and 1200 to 1630. Telegrams can be sent from the Post Office situated in Patancheru village. Postage stamps can be purchased from the Housing Office from 1400 to 2200.

**Emergency - In case of any emergency please contact the Main Gate Security - Tel. 117.**

**Useful Telephone Numbers**

**ICRISAT, Patancheru: 224016-20 and 224066-70**

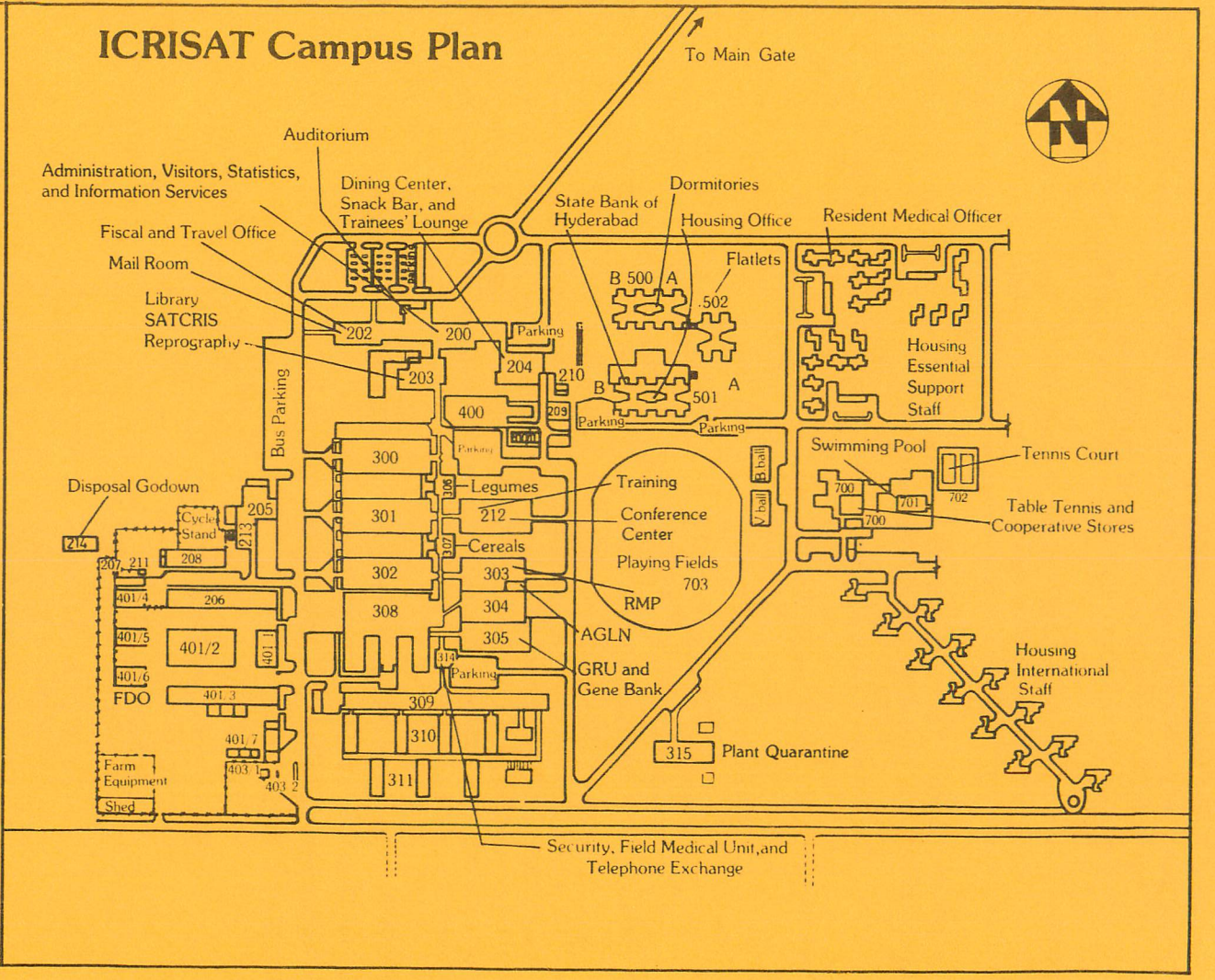
ICRISAT Campus

| | Office | Residence |
|---|---|---|
| Housing and Food Services | 550 | |
| Mr D.A. Evans<br>Manager<br>Housing and Food Services | 542 | 682 |
| Mr B.R. Revathi Rao<br>Asst.Manager, Housing | 541 | 191 |
| Mr S. Mazumdar<br>Asst.Manager, Food Services | 547 | 180 |
| Dr N. Surya Prakash Rao<br>Resident Medical Officer | 638 | 113 |
| Dr D.L. Oswalt<br>Principal Training Officer | 361 | 673 |
| Telephone Operator | 9 | |
| Main Gate Security | 117 | |

3-digit numbers are ICRISAT extentions, for all other calls dial 9 and ask the operator to assist you.

## Legend

| Bldg. No. | Designation |
|---|---|
| 200 | Admn., Visitors, Statistics, and Info. Services |
| 202 | Reception, Auditorium, Fiscal, Travel, Mail Room, Personnel, and Computer Services |
| 203 | Library, SATCRIS, Reprography |
| 204 | Dining Center, Snack Bar, and Trainees Lounge |
| 205 | Canteen |
| 206 | Purchase and Supplies Division (PSD) |
| 209 | Laundry |
| 212 | Training Offices and Classrooms, Conference Center, RMP |
| 300, 301, 302 | Laboratories |
| 303 | Laboratories, AGLN Office, and RMP Program Office |
| 304 | Crop Work Area |
| 305 | Laboratories, CCRN Office, and Genetic Resources Unit |
| 306 | Legumes Program Office |
| 307 | Cereals Program Office |
| 308 | Crop Work Area |
| 309 | Plant Growth Facility, Stem Borer, Radioisotope and Nematology Laboratories |
| 310 | Greenhouses |
| 311 | Screenhouses |
| 314 | Security, Field Medical Unit, and Telephone Exchange |
| 315 | Plant Quarantine Unit |
| 401/1 | PPS Eng. and Admn. Wings |
| 401/2&3 | PPS Workshops and Stores |
| 401/4 | Transport |
| 401/6 | Farm Development Operations (FDO) |
| 403/1&2 | Petrol Pump and Diesel Pump |
| 500, 501 | Dormitories and Housing Office |
| 502 | Flatlets |
| 700 | Table Tennis and Cooperative Stores |
| 701 | Swimming Pool |
| 702 | Tennis Court |
| 703 | Playing Fields |



# Consultants' Meeting on Uses of Grain Legumes

**27 - 30 March 1989**

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