Utilization of Chickpea and Groundnut in Pakistan

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Abstract. *Food legumes are important and economical sources of protein and other nutrients in diets in Pakistan. The total annual production of chickpea is 372,000 t and that of groundnut is 52,000 t 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, *and flour, whereas groundnut is mainly consumed as whole kernels. The nutritive value of chickpea-based products, prepared from desi and kabuli types, and of groundnut are discussed.*

Introduction

Food legumes, being economical sources of protein, calories, and certain vitamins and minerals, are an essential component in the diet of 700 million people (Khan 1987). However, consumption of legumes is restricted due to the scarcity caused by their present low yields and consequent higher cost, and due to certain defects in their nutritional and food use qualities (Elias and Bressani 1974; Khan and Ghafoor 1978).

Food legumes improve soil fertility, and the rotation of grain legumes with cereals increases the yield of cereals and reduces weed, disease, and insect problems (Borlaug 1973). Chickpea is reported to have medicinal properties, its seeds being astringent and antibilious (Khan et al. 1989). When roasted, the grain is considered to be an aphrodisiac and the fried seeds are diuretic. Hypocholestrolaemic effects and diabetic management have also been associated with chickpea (Chopra et al. 1956).

In Pakistan cereals constitute the bulk of the average diet. They are known to be limited in lysine content (Khan and Eggum 1978a; Khan 1981). In contrast, legumes are a rich source of lysine, but are limited in sulfur amino acids (Khan et al. 1979; Khan 1980; Khan et al. 1987). Combinations of cereals and legume have been reported to meet the protein requirement of various age groups in the population (Khan et al. 1976; Khan et al. 1977; Khan and Eggum 1978b; Khan et al. 1979; Khan and Eggum 1979; Khan et al. 1979).

Legume production in Pakistan has not only remained stagnant but has actually suffered a set-back in terms of per capita availability. Recently, however, more attention has been paid to developing high-yielding, disease- and insect-resistant legume cultivars, and to improving the economy of their cultivation.

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Table 1. Area and production of chickpea and groundnut in Pakistan, 1978/79 to 1987/88.

	Chickpea		Groundnut	
Year	Area ('000 ha)	Production ('000 t)	Area ('000 ha)	Production ('000 t)
1978/79	1224.4	537.8	36.5	45.5
1979/80	1128.5	313.4	40.8	50.3
1980/81	842.9	336.9	46.5	57.4
1981/82	901.6	293.7	59.7	72.2
1982/83	892.9	491.0	69.3	84.1
1983/84	919.6	521.9	72.6	88.0
1984/85	1013.7	523.7	59.1	69.1
1985/86	1033.3	586.2	54.9	63.1
1986/87	1082.1	583.3	62.8	75.0
1987/88	820.6	371.5	66.5	52.1

Source : Government of Pakistan. Ministry of Food and Agriculture, Food and Agriculture Division, (Planning Unit) All Pakistan Final Estimates for Chickpea and Groundnut, 1987/88.

The present paper deals with the utilization of chickpea and groundnut in Pakistan, and with the identification of areas for further research and development.

Area and Production Trends

The area sown under chickpea and chickpea production have remained static in recent years, except from 1979/80 to 1982/83 and during 1987/88 (Table 1). Ascochyta blight and weather conditions were the major causes of these fluctuations; during these periods the area sown declined by 33%, and production by 31%. Groundnut is mainly grown as a cash crop and most of the produce is consumed as roasted nuts. About 92% of the total area under groundnut lies in the Punjab, 7% in the North West Frontier Province, and 1% in Sind (Khan and Quayyum 1986). There has been a 45% increase in sown area, and a 15% increase in production, from 1978/79 to 1987/88 (Table 1). The present yield is still lower than the potential yield obtained on research stations.

Availability

The per capita consumption of pulses in Pakistan is 15.7 kg annum^{-1} (National Nutrition Survey 1988). Legumes contribute 8% protein, 8% calories, and 7% iron to the average diet in Pakistan. During 1987/88, the per capita availability of chickpea was 3.04 kg annum^{-1}, and the per capita availability of groundnut was 0.45 kg annum^{-1}.

Processing of Chickpea

Before being consumed, chickpea is subjected to primary processes i.e., dehulling, splitting, grinding, puffing, parching, and roasting. The main effect of this processing is to

improve appearance, texture, culinary properties, and palatability; to decrease dry-matter content, and alter the bioavailability of nutrients (Kurien 1987).

Dehulling

Dehulling chickpea seed to prepare *dhal* involves pretreatment to loosen the seed coat from cotyledons, splitting, and dehusking.

Inefficient traditional household milling techniques yield 63% *dhal*, and commercial milling techniques yield only 70% *dhal* (Malik 1980). Household processing of chickpea into *dhal* reduces the levels of protein, calcium, iron, phosphorus, thiamine, riboflavin, and niacin it contains (Pushpamma et al. 1983). There is an urgent need to develop loose-husked chickpea varieties and to improve milling technology.

Puffing

Puffing chickpea improves its flavor, modifies its texture, and helps in dry or wet grinding (Kurien et al. 1972). For puffing, the seeds are soaked in water and then roasted on heated sand at 200-500°C for 1-2 min. The roasted chickpea is gently rubbed against a coarse surface to break the husk, which is then removed by winnowing. Processors prefer chickpea cultivars grown in specified agroclimatic tracts, which are known to give superior products with good aroma (Kurien 1984). Grains with 12-14% husk content are good for puffing (Kurien 1987). There is a need to study the factors affecting puffing and develop methods to increase puffing expansion.

Grinding

Whole chickpea, or *dhal*, is ground dry to a flour, known as *besan*. The eating quality of many chickpea flour-based products depends on flour composition, the degree of fineness of grinding, mesh grades, and cooking conditions (Kurien et al. 1972). Traditional processing methods need to be refined to improve the nutritional quality of chickpea and increase the consumer appeal of products made from it.

Traditional Uses of Chickpea

Chickpea is used in many forms, from fresh green seed to dried whole seed, *dhal*, and flour. Methods of processing used to make traditional chickpea-based products include boiling, roasting, frying, and puffing (largely a commercial process) (Table 2).

Green immature chickpea is used as vegetable. It is mixed with meat or vegetables to make curries, with rice to make *pilau*, and after shelling the roasted pods the seeds are used as a snack.

The most common method of processing whole chickpea is by boiling it, either in an open pan, or in a pressure cooker. The seed is usually soaked overnight in water sometimes with baking soda before cooking, to reduce cooking time. Seed size is important since it affects such processing operations as cleaning, decortication, and sugar coating. In general,

Table 2. Utilization of chickpea in Pakistan.

Form	Types of product	Processing conditions
Fresh green seed	Curry	Mix with meat or vegetables, boil (30–40 min) and serve with bread or boiled rice.
	Pilau	Mix with rice and boil or steam (30 min).
	Holan	Roast pods, and consume as a snack.
Whole dry seed	Curry	Soak, boil alone or mixed with meat or vegetable (10–30 min), and serve with bread or boiled rice.
	Chaat	Soak, boil (10–30 min) mix with potato or fruits, and serve as a snack.
	Pilau	Soak, boil with rice (30 min) steam (5 min), and consume as a main meal.
	Roasted chickpea	Soak and puff (240–250°C, 2–3 min), dehusk, and consume as a snack.
	Sweet *chanay*	Puff, coat with sugar, and consume as a snack.
Dhal	Curry	Soak, boil alone or mixed with meat or vegetable (10–30 min), and serve with bread or boiled rice.
	Kichri	Soak, boil with rice (20–30 min), steam (5 min), and use as a main meal.
	Shami kabab	Soak, boil with minced meat (10–30 min), make into cutlets, fry in oil, and serve as a snack.
	Haleem	Soak, boil with ground wheat, rice, maize, millet, and lentil, mash, and meat, (boil 30–60 min), and serve alone or with bread or boiled rice.
	Namkeen dhal	Soak, fry (20 min), and serve as a snack.
	Halwa	Soak, boil in water or milk, mash, add sugar, fry and serve as a sweet.
Flour (*besan*)	*Missi roti*	Mix with wheat flour, make into *roti* bake (2–3 min), and consume as a main meal.
	Pakora	Make thin batter, mix with vegetables and fry (2–3 min), and consume with bread or serve as a snack.
	Dhal sawayan	Make dough, extrude as noodles, fry (3–5 min), and serve as a snack.
	Halwa	Roast with ghee (clarified butter), add sugar syrup, make into thick paste, and serve as a sweet.

larger seed is considered to be of better quality and this is also preferred by consumers. Kabulis are preferred to desis. The mean cooking time of dry desi is 125 min and of kabuli is 114 min. These times are reduced to 38 min for desi and 33 min for kabuli when soaked overnight in water, and further reduced to 29 min for desi and 23 min for kabuli when soaked in a 0.5% sodium bicarbonate solution (Khan 1988). In a pressure cooker kabulis soaked overnight cook in 10 min.

Dhal is cooked until tender and soft depending on the desired texture of the finished product. *Dhal*-based products are widely used in the home and on a commercial scale, to make curry, *kichri*, and *shami kabab*.

In Pakistan, chickpea flour is a major ingredient in snacks, such as *pakoras*, and in sweets. It is also used in ground meatball preparations, and in coating fried fish and chicken pieces. Chickpea flour is also blended with wheat flour to bake *missi roti*, a bread commonly consumed by diabetic patients.

Many of the procedures adopted in product development have certain beneficial side effects. Soaking reduces the trypsin inhibitor, hemagglutinating activity, and flatulence sugars, since some of the inhibitors leach out during soaking (Kakade and Evans 1966). Boiling softens the husk, due to the reaction of phytate with insoluble calcium (Ca) and magnesium (Mg) pectates in the cell walls to produce soluble pectate. The influence of the seed coat cell wall is a factor governing cooking time and quality. During the roasting of *dhal*, a brown color develops due to the Maillard reaction, and the aroma of the seed improves, imparting a highly acceptable quality to the roasted product. In puffing, the seed becomes light due to shrinkage of the endosperm and loss of water, and the seed starch is dextrinized (Pushpamma and Geervani 1987).

Nutritive Value of Chickpea-based Products

In practical dietetics, nutritive value and the availability of dietary constituents are more important in cooked food than in raw foods. The ingredients of dishes that go to make desi and kabuli chickpea products, and the nutrient content of cooked chickpea products are presented in Tables 3 and 4. About 50-75% of the daily calcium requirements of adult males and females can be provided by 100 g of dry chickpea. On a dry-weight basis, 100 g of roasted chickpea and *missi roti* can meet 50-100% of the daily iron (Fe) requirements of an adult male. As Fe-deficiency anemia is a public health problem in Pakistan, the use of chickpea could help to ameliorate iron deficiency in the local population.

Nutritive Value of Chickpea-based Meals

The nutritive value of composite dishes is of great importance, and the nutritional significance of these dishes lies in the frequency with which they are consumed. The composition of some chickpea-based meals commonly used in Pakistan, and their nutrient content

Table 3. Ingredients of some Pakistani chickpea products.

Products	Chickpea			Wheat flour (g)	Potato (g)	Fat (g)	Onion (g)	Chi-lies (g)	Salt (g)	Spices (g)	Sugar (g)
	Variety	Form	Mass (g)								
Curry	Kabuli (Cholla)	Whole seed	200	-	-	30	38	3	8	2	-
	Desi (CM 72)	Dhal	140	-	-	16	28	3	8	2	-
Missi roti	Desi (CM 72)	Flour	100	200	-	-	15	10	2	-	-
Pakora	Desi (CM 72)	Flour	200	-	50	250	30	1	9	-	-
Chaat	Kabuli (Cholla)	Whole seed	200	-	50	-	30	1	8	-	-
Halwa	Desi (CM 72)	Flour	200	-	-	110	-	-	-	-	150
Roasted chickpea	Desi (CM 72)	Whole seed	200	-	-	-	-	-	-	-	-

Source : Khan and Jaffery 1989.

Table 4. Nutrient content (dry basis) of some Pakistani chickpea products.

Products	Protein (N × 6.25)	Fat	Carbohydrate	Crude fiber	Ash	Energy [KJ (100 g)$^{-1}$]	Ca	P	Fe	Zn	Mn	Cu
		(g 100 g^{-1})					(mg 100 g^{-1})					
Whole kabuli curry	17.7	12.6	60.9	4.4	4.4	1684	360	315	5.3	3.9	2.6	1.1
Dhal desi	20.3	12.8	60.9	1.6	4.4	1647	226	273	3.9	3.3	2.6	0.7
Missi roti	14.6	3.1	75.9	4.1	2.3	1395	239	284	6.9	4.6	5.4	0.9
Pakoda	17.2	12.4	53.4	11.1	5.9	1898	239	243	7.2	2.5	2.9	0.8
Chaat	19.3	5.3	68.2	3.9	3.3	1555	328	279	5.8	3.6	1.6	0.9
Halwa	8.9	21.8	63.7	4.4	1.2	2573	247	126	3.8	1.8	1.5	0.6
Roasted chickpea	21.1	5.0	60.3	10.6	3.0	1513	268	264	8.2	5.4	2.6	1.1

Source : Khan and Jaffery 1989. et al. 1995

Table 5. Composition (g) of some Pakistani chickpea-based meals.

Ingredients	Meals[1]		
	1	2	3
Wheat flour	120.0	-	-
Rice	-	30.0	-
Chickpea *dhal*	18.0	15.0	-
Chickpea flour (*besan*)	-	-	10.0
Semolina (*suji*)	-	-	20.0
Onion	12.0	-	-
Sugar	-	-	30.0
Vegetable oil	10.0	8.0	12.0

1. Meal 1 = Wheat bread + chickpea *dhal*, 2 = *Kichri*, 3 = *Halwa* (*suji* + *besan*).
Source : Khan and Eggum, 1978, 1979.

are given in Tables 5 and 6. In a well-balanced diet, 10-15% of the total energy requirement is usually derived from protein, 55-70% from carbohydrate, and 20-30% from fat (Passmore and Eastwood 1986). A meal containing wheat bread and chickpea *dhal* can provide 12% of the total calories from protein, 55% from carbohydrate, and 18% from fat (Table 6); while for *kichri*, 10% is derived from protein, 48% from carbohydrate, and 32% from fat. *Halwa* provides 6% of the total calories from protein, 57% from carbohydrate, and 32% from fat. It is evident that the first two meals compare favorably with the characteristics of a well-balanced diet.

True protein digestibility (TD), biological value (BV), net protein utilization (NPU), and net dietary protein calorie % (NDpCal%) of chickpea-based meals are presented in Table 7. The NDpCal% of meals varied between 4.3 and 7.3 (Khan and Eggum 1978b; 1979). According to FAO (1965) the protein allowances in terms of NDpCal% for different age groups are 8.0 for infants, 7.8 for toddlers, 5.9 for children (4-9 years), 8.4 for adolescents, 4.6 for adults, and 9.5 for lactating mothers. When judged in terms of NDpCal%, the protein values of a wheat bread and chickpea *dhal* meal, and of *kichri* are only

Table 6. Chemical composition (dry basis) of some chickpea-based Pakistani meals.

Meals	Protein (N × 6.25)	Fat	Carbohydrate	Crude fiber	Ash	Energy [KJ (100 g)$^{-1}$]	Ca	P	Fe
		(g 100 g^{-1})					(mg 100 g^{-1})		
Wheat bread + chickpea *dhal*	14.3	9.3	65.0	1.2	2.3	1978	392.0	196.0	7.6
Kichri	11.4	18.6	60.7	1.5	1.7	2137	51.3	184.7	3.5
Halwa suji + Besan	7.0	18.2	71.7	0.9	0.7	2124	32.9	82.1	2.1

Source : Khan and Eggum 1978; 1979.

Table 7. Protein quality (%) of Pakistani chickpea-based meals.

Meals	True digestibility	Biological value	Net protein utilization	Net dietary protein calories
Wheat bread + chickpea *dhal*	92.0	66.0	60.0	7.3
Kichri	92.0	71.0	65.0	6.1
Halwa suji + *Besan*	99.0	75.0	74.0	4.3

Source : Khan and Eggum 1978; 1979.

adequate to meet the protein requirements of children (4-9 years) and adults. Similar results have been reported by Ali and Miller (1963) and Hussain et al. (1981). The NDpCal% of *halwa* is 4.3 and is inadequate to meet protein requirements, but it can be used as a source of energy (Khan and Eggum 1979). Similar results have been reported by Rana et al. (1966). Cereals and legumes will continue to be the major sources of protein and calories in Pakistan and protein needs can be met provided legumes are made available at the required level.

Traditional Uses of Groundnut

Groundnut is widely used in Pakistan in the roasted form as a snack food by all age groups, but more by preschool and school-going children. It is also used in confectionery and baked products.

Over 300 uses of groundnut have been developed, including as food, feed, and in the manufacture of industrial products. These products however have not been popularized because groundnut production in Pakistan is low. Since the entire produce is consumed as roasted nuts, it becomes imperative to determine their nutritional quality.

Nutritive Value of Roasted Groundnuts

The chemical composition, calorific values, and protein quality of some varieties of groundnut grown in Pakistan are given in Table 8. The protein content was highest (30.3%)

Table 8. Nutritive value of roasted groundnuts consumed in Pakistan.

Varieties	Protein	Fat	Fiber	Ash	Energy [KJ (100 g)$^{-1}$]	Ca	P	Fe	Zn	NDpCal (%)
	(g 100 g^{-1})					(mg 100 g^{-1})				
Banki	27.9	46.7	5.0	3.9	2623	55.2	288.2	1.3	4.7	8.5
Hsuji	26.8	48.2	4.9	3.8	2661	64.0	310.9	1.5	4.4	8.6
Kurram	30.3	46.0	4.3	3.3	2657	62.8	348.2	1.4	6.0	8.4

Source : Khalil and Chughtai 1983.
NDpCal % = Net dietary protein calorie percent.

in *kurram*. With respect to the Recommended Dietary Allowances, 100 g of roasted kernels can furnish 7% of calcium, 39% of phosphorus (P), 14% of iron, and 33% of zinc (Rana and Khan 1986). Lysine was the first limiting amino acid in all varieties. The protein value, which is an index of nutritional quality, is a product of both the quantity and the quality of proteins, and is expressed in terms of NDpCal% for roasted groundnut. The NDpCal% values vary between 8.4 and 8.6, and are adequate for all age groups. Groundnut and its derivatives could enter into commercial competition with other oilseeds if production were able to meet the demand.

Future Research Areas

Chickpea

Higher and more stable yields should be the primary objective of chickpea improvement programs. The increase in yield should not be at the expense of acceptability in the marketing system, or of protein or lysine content. The most important factors to breed for are: sulfur amino acids, tryptophan, lysine, protein, large seed size, regular seed shape, low decortication loss, low gasogen (flatus producing substances) content, and resistance to pest infestation during storage.

Economic studies should be carried out on cultural practices, including use of fertilizers, pesticides, and other direct inputs, relative to returns obtained from different legume genotypes grown in different environments and locations. Reassessments will need to be made for new varieties as these are developed. The effect of improved agronomic practices should be more carefully studied, particularly on the vitamin and mineral contents of chickpea seed. Studies concerning the interaction between cultivars and such factors, and their effect on nutritional composition would be desirable.

It is particularly pertinent to study the functional properties and biochemical changes in proteins and carbohydrates induced by cooking, because the digestibility of protein, and the availability of amino acids are low even after cooking. The losses and bioavailability of minerals and vitamins should also be studied. The presence of hemagglutinins, cyanogenic glucosides, estrogenic factors, metal-binding constituents, and toxic amino acids in chickpea also needs to be investigated. The effect of chemical treatments to control insect infestation and microbial growth on nutritional quality should be examined.

Research is needed on storage stability, postharvest technology including processing, food-product development, cooking quality, and consumer acceptance. The processing technologies that are largely traditional, and partially mechanized versions of age-old home-scale techniques, need to be further improved after proper understanding of the principles involved.

Groundnut

More area should be brought under improved technology for groundnut cultivation. Farmers should be encouraged to sow high oil yielding varieties. Breeding efforts should

focus on improving the quantity and the quality of oil and meal, and reducing the various anti-nutritional factors. Groundnut can only be crushed for oil in Pakistan if there is a market, and a fair price to the farmers for their crop. Machinery for shelling seed, expelling oil, and processing oilcake should be made easily available. Groundnut seed may be partially defatted to produce kernels high in protein and low in oil content. Such nuts have longer shelf-life and can be processed into a variety of final products by using various additives. The level of aflatoxins in fresh and processed groundnut products should be continuously monitored and methods for detoxification of the contaminated products should be improved.

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