Short Communication

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PHYSICO - CHEMICAL CHARACTERISTICS OF COMMONLY CONSUMED LEGUMES AFTER DOMESTIC PROCESSING

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Food legumes, widely grown and consumed throughout the world are excellent sources of proteins (20 - 25%) and carbohydrates (50 - 60%). They are also fairly good sources of dietary fibre, minerals and vitamins. However, presence of tannins, phytic acid and other anti-nutritional substances reduce the availability of protein and other nutrients in legumes (Morrow 1991; Van der Poel *et al* 1991; Stanley 1992). Most of the nutrients and anti-nutrients are lost during soaking and cooking processes (De-Leon *et al* 1992). Physical characteristics of certain legumes are associated with these soaking and cooking processes (Phirke *et al* 1982; Attia *et al* 1994). However, digestibility of starch and protein of the legumes is not well documented in literature. This paper reports the effect of cooking on nutrients, anti-nutrients and digestibility of protein and starch of commonly used legumes. Physical characteristics of these legumes were also studied after soaking them in simple water.

Raw form of five legumes (black grams, chick-peas, lentils, red and white kidney beans) were obtained from Ayub Agriculture Research Institute, Faisalabad (Pakistan). Physical characteristics including water absorption capacity (Sefa-Dedh and Stanly 1979), swelling capacity (Akinyele *et al* 1986), seed density (Phirke *et al* 1982), and cooking time (Singh *et al* 1991) of the legumes were determined after soaking in water for 4 h. The ash, protein, soluble sugars, starch, tannins, phytic acid, protein and starch digestibility was estimated before and after cooking the pre-soaked legumes (AOAC 1990).

Table 1 summarized the physical characteristics of raw legumes. Apparent seed density of the legumes were found to be from 0.48 to 1.85g/ml. Cooking time of unsoaked whole seeds of these five legumes showed wide variations ranging from 16 - 130 min depending upon the size and hardness of seeds. Cooking time was reduced by 34.61 to 43.75%, as a result of soaking in water for 4 h. Reduction in cooking time could be the result of absorption of sufficient water from the soaking media which ultimately decreased hardness of legumes.

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Table 1
Physical characteristics of raw legumes

Legumes	Legumes apparent seed density (g /ml)	Water absorption capacity (g /100g)	Swelling capacity (g /100g)	Cooking time (min)
Black gram	1.16	25.60	73.00	110
Chick-peas	1.85	23.80	84.53	75
Lentils	0.48	15.42	32.72	16
Red kidney beans	1.23	34.74	74.39	130
White kidney beans	1.10	27.80	66.07	45

Black grams, chick-peas, lentils, red and white kidney beans contained 19.43 - 26.00% protein, 2.73 - 3.73% minerals, 5.50 - 8.46% soluble sugars and 37.62 - 47.00% starch (Table 2). These nutrients were lost to various extents during cooking process. About 14.78 to 21.83% proteins were lost from these five legumes on cooking. These losses in proteins are attributed to partial removal of certain essential as well as non essential amino acids along with other nitrogenous compounds which were formed as a result of chemical degradation of complex molecules of proteins into simple water soluble amino acids due to high temperature and pressure. About 18.99 to 39.50% minerals, 26.70 - 36.86% soluble sugars and 35.38 - 55.55% starch contents were lost as a result of cooking of the legumes. Earlier workers also reported that cooking caused some of the bean cells to separate rather than to break because of which cell contents (proteins, minerals and sugars) were released to the surrounding media and consequently, caused reduction in the nutrients of beans (Kon 1979; Rincon *et al* 1993).

The amount of neutral detergent fibre (NDF), acid detergent fibre (ADF), cellulose, hemicellulose and lignin in these five food legumes was 19.44 - 24.98%, 4.23 - 8.49%, 2.67 - 6.60%, 12.74 - 20.78% and 1.40 - 1.89%, respectively (Table 2). Variable amounts of these dietary fibre components from the legumes were lost as a result of pressure cooking. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) contents of these legumes reduced to 11.52 - 18.32% and 10.87 - 19.66% because of cooking. Reduction in cellulose by 11.49 - 21.55% and hemicellulose by 17.85 - 27.22% was observed whereas 3.03 - 7.40% lignin contents were reduced during cooking process. These results are consistent with the findings of earlier workers who found reduction in cellulose and hemicellulose contents of legumes during different cooking processes (Vidal-Valverde and Frias 1991).

Phytic acid and tannin contents in the food legumes were found to be 223 - 599 mg /100g and 164 - 371 mg /100g, respec-

Table 2
Nutrients, anti-nutrients and dietary fibre components of raw legumes

Legumes	Nutrients %				Anti-nutrients mg /100g		Dietary fibre components %				
	Protein	Minerals	Soluble sugar	Starch	Phytic acid	Tannins	NDF	ADF	Cellulose	Hemicellu-loses	Lignin
Black grams	19.43	3.07	7.09	41.26	223.30	164.70	21.23	8.49	6.60	12.74	1.89
Chick-peas	22.62	2.73	5.50	42.00	289.00	186.70	21.31	7.22	5.57	16.14	1.65
Lentils	26.00	3.07	5.21	37.62	351.30	315.67	24.48	4.23	2.83	20.25	1.40
Red kidney beans	23.69	5.66	7.32	44.00	599.70	371.69	24.98	5.20	3.66	20.78	1.54
White kidney beans	22.48	3.73	8.46	47.00	388.00	189.00	19.44	4.37	2.67	15.07	1.70

Table 3
Digestibility of protein and starch of raw legumes

Legumes	Digestibility %	
	Protein digestibility %	Starch digestibility %
Black grams	37.00	44.44
Chick-peas	39.68	45.00
Lentils	45.72	42.00
Red kidney beans	33.77	48.00
White kidney beans	35.29	49.37

tively (Table 2). About 53.43 to 66.11% phytic acid and 25.23 - 50.00 % tannin contents were reduced when water soaked legumes were cooked in a pressure cooker for 15 min. Reduction in anti-nutrients have already been observed by earlier workers during cooking of cowpea, winged beans and field beans (Laurena *et al* 1984;Ogun *et al* 1989).

Protein and starch digestibility of the raw legumes varied from 33.77 - 45.72 and 42.00 - 49.37%, respectively (Table 3). The digestibility of protein and starch was improved by 51.07 - 66.09% and 64.31 - 76.19%, respectively on cooking legumes. Improvement in starch digestibility by 15.28 to 25.92% was higher than protein digestibility of these legumes on cooking. Better improvement in starch digestibility could be attributed due to hydrolysis of starch under drastic conditions of heating under pressure. Mbofung *et al* (1999) also reported distinct improvement in starch digestibility of cowpeas after cooking. Partial removal of anti-nutrients (phytic acids, tannins) might be responsible for improving the digestibility of protein and starch of the legumes. However, it is also possible that some structural changes might have occurred which increased the susceptibility to enzymatic attack and ultimately improved the digestibility of these two nutrients after cooking process.

Key words: Legumes, Nutrients, Anti-nutrients, Physical characteristics, Soaking, Cooking.

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