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Nutritional quality of the selected whole and processed food grains grown in Central Telangana zone of Andhra Pradesh

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Proximate analysis of a food sample determines the total protein, fat, carbohydrate, ash and moisture reported as the percentage composition of the product. The quality of the assays and the definition of the composition (*i.e.* which components are included in the measurement) vary. The samples analyzed were jowar, maize, blackgram and bengalgram. The processing techniques adapted were dehulling for jowar, blackgram and bengalgram and flour making for maize. Hence, the present investigation was taken up with the objective of determining the proximate content in the selected whole and processed food grains at Central Telangana Zone of A.P. The proximates moisture, protein, fat, ash, fibre and carbohydrate were analyzed in the samples by using standard AOAC methods. The results revealed that statistically significant difference at 5 per cent level was observed with regard to all the nutrients analyzed between the whole and the processed samples, except protein in jowar and maize, fat and ash in jowar and carbohydrate in jowar, maize and blackgram, which were statistically not significant. The whole grain samples contained lower content of moisture, protein, fat, ash and carbohydrate than processed grains. Except fibre whole grains contained greater fibre content than processed grain.

Key Words : Food grains, Proximates, Whole, Processed, Cereal, Pulses

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INTRODUCTION

Cereals are the cheapest sources of food energy and contribute a high percentage of calories and proteins in the diets of Indian population. Pulses are considered as poor man's meat due to their high protein content ranging from 20 per cent to 40 per cent (Mahajan and Chattopadhyay, 2000). India is the largest producer of pulses in the world. Pulses are rich source of protein, minerals, vitamins and carbohydrates, hence useful for vegetarian class of society. Processing like milling, dehulling, soaking, germination and cooking so as to enhance digestibility and nutritive value (Srivastava and Srivastava, 2003). The combination of cereal and pulse resulted in a product with a higher nutritive value, as compared to products using cereal or pulse alone. Cooking practices like soaking, fermentation and boiling enhanced the nutritive value of the products (Kumari *et al*., 2003).

Proximate analysis of a food sample determines the total protein, fat, carbohydrate, ash and moisture reported as the percentage composition of the product. The quality of the assays and the definition of the composition (*i.e.* which components are included in the measurement) vary. The diverse range of analytical methods used introduces small differences among the compositional values that require the source to be identified and relative standard deviation (RSD) to be reported with the data.

The estimation of proximate content in food grains is essential to know the difference between whole and processed food grain. Hence, the present investigation was taken up with the objective of determining the proximate content in the selected whole and processed samples of jowar, maize, blackgram and bengalgram at Central Telangana Zone of A.P.

METHODOLOGY

Central Telangana Zone of Andhra Pradesh was selected

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for the study. Three districts were covered under this zone *i.e.*, Warangal, Medak and Khammam. Samples of jowar, maize, blackgram and bengalgram were procured from farmers in the selected villages of Central Telangana Zone of Andhra Pradesh. The whole and processed food grain samples were collected randomly from the farmers. The pre and post processing techniques adopted for the present study were dehulling for jowar, blackgram and bengalgram and making flour for maize.

All the grains were cleaned manually to remove foreign materials and unhealthy grains and dried. The dried grains of jowar, blackgram and bengalgram were dehulled and husk of the grain was removed manually. Maize grains were milled into a fine powder in a flour mill.

Estimation of moisture content:

The moisture content of the whole and processed samples was determined, using the method of A.O.A.C. (1990).

Estimation of protein content:

The protein content of the whole and processed samples was determined, using the method of AOAC (2005). The amino nitrogen in various nitrogenous compounds in biological samples get converted in to total organic nitrogen in Leco analyzer by combustion of sample through Doumas method, there by protein content is arrived.

Estimation of ash content:

The ash content of the whole and processed samples was determined, using the method of AOAC (1990). When foods and food products are heated to temperatures of 500^{0}C -600^{0}C, the water and other volatile constituents are evolved as vapours and the organic constituents are burned in the presence of oxygen of the air to carbon-dioxide and oxide of nitrogen and also eliminated together with hydrogen as water. The mineral constituents remain in the residue as oxides, sulphates, phosphates and chlorides and this is organic residue constituents the ash of food products.

Estimation of fat content:

The fat content of the whole and processed samples was determined, using the method of AOAC (1981). Fat is extracted as crude ether extract of the dry material.

Estimation of fibre content:

The fibre content of the whole and processed samples was determined, using the method of AOAC (1990). The sample was allowed to boil with dilute sulphuric acid (1.25%) and dilute sodium hydroxide (1.25%) and the remaining residue after these digestions was taken as crude fibre.

Estimation of carbohydrate content:

Carbohydrate of the selected food grains was determined by difference *i.e.*, by subtracting from 100 the sum of the values (per 100 g) for moisture, protein, fat, ash and crude fibre.

Statistical analysis:

All the results were statistically analyzed to test significance of variance between treatments and crops by using analysis of variance (ANOVA) (Snecdor and Cochran, 1983).

OBSERVATIONS AND ASSESSMENT

The mean proximate composition of the food grains is given in Table 1.

Moisture content:

Moisture content of the selected grains (jowar, maize, blackgram and bengalgram) was observed (Table 1and Fig. 1). The moisture content of whole and processed jowar was 10.21 per cent and 10.60 per cent, respectively. It was 10.34 g per cent and 10. 80 g per cent for whole and processed maize, respectively. Whole and processed blackgram contained 9.65 g per cent and 10.60 g per cent moisture, respectively. These values were significantly equal with the recommended values given by NIN and Gopalan *et al*. (2004). The moisture content was 7.65 g per cent and 8.50 g per cent in whole and processed bengalgram. These values were coinsided with the recommended values given by NIN (10.9 g%) and (10.38 g%) as reported by Amin *et al.* (2005) and Gopalan *et al*. (2004), respectively.

It was clearly observed that the moisture content of the processed grains was greater than that of the whole grains. The critical difference obtained for moisture was 0.3842. Finally, the moisture content was statistically significant at 5 per cent level between whole and processed samples. The difference between whole and processed samples of each grain was observed to be greater than the critical difference value.

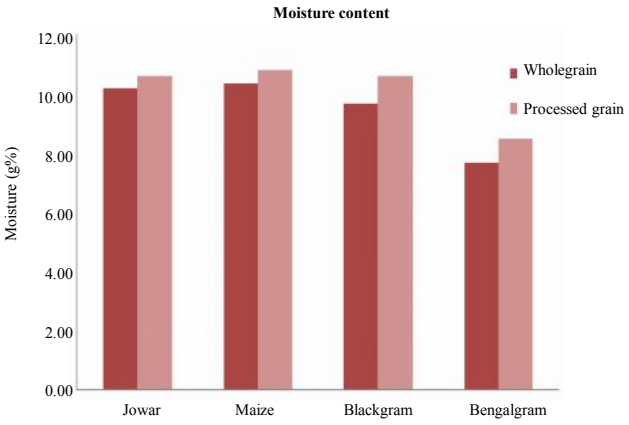

Fig. 1. Moisture content of selected food grains

Table 1. Proximate composition of selected whole and processed food grains

Proximates	Samples	Jowar	Maize	Blackgram	Bengalgram
Moisture (g %)	Whole	10.21 ± 0.064	10.35± 0.22	9.65±0.23	7.65± 0.043
	Processed	10.60± 0.142	10.80 ± 0.007	10.60±0.14	8.50±0.29
	CD value	0.385*	0.45*	0.95*	0.85*
Protein (g %)	Whole	8.88±0.033	7.77±0.017	21.82±0.097	21.48±0.24
	Processed	8.95±0.014	8.17±0.0043	23.88±0.035	23.41±0.81
	CD value	0.072 ^{NS}	0.3975 ^{NS}	2.067*	1.9335*
Fat (g %)	Whole	1.70±0.12	1.25±0.0029	0.98 ± 0.119	3.97±0.12
	Processed	1.87± 0.14	1.51± 0.126	1.64± 0.048	4.30 ±0.12
	CD value	0.1721 ^{NS}	0.261*	0.6551*	0.329*
Ash (mg %)	Whole	1.50 ± 0.0022	1.30 ± 0.0036	3.69 ± 0.152	3.09 ± 0.014
	Processed	1.65 ± 0.071	1.64± 0.074	4.30± 0.007	3.78 ± 0.003
	CD value	0.1485 ^{NS}	0.3455*	0.6005*	0.6955*
Fibre (g %)	Whole	1.30 ±0.012	2.68 ±0.007	2.81 ±0.012	2.68 ±0.014
	Processed	0.95 ±0.006	1.97±0.0028	0.78±0.0027	1.85±0.007
	CD value	0.3524*	0.7064*	1.027*	1.8326*
Carbohydrate (g %)	Whole	76.66±0.16	76.63±0.22	57.86±0.318	61.13±0.41
	Processed	75.96±0.099	75.89±0.051	56.78±0.152	58.14±1.19
	CD value	0.695 ^{NS}	0.7475 ^{NS}	1.0815 ^{NS}	2.986*

*Figures with superscripts are significantly different 5% level ($p < 0.05$).
CD value of moisture- 0.3842, protein - 0.6926, fat- 0.2465, ash -0.1498, fibre- 0.205 and carbohydrate- 1.0976. W = whole grain ; P= processed grain; CD = critical difference ; NS = Non-significant at 5 % level .

Fat content:

The fat content of the jowar whole was 1.70 g per cent and jowar processed was 1.87 g per cent (Fig. 2). These values were comparable to the fat content of jowar (1.90 g %) as reported by Gopalan *et al*. (2004). Saldivar *et al.* (1995) also reported that sorghum contained less oil (1.0 g%) and significantly more waxes. Lipids in sorghum are located in the scutellum and consist mainly of non-polar or neutral lipids (93.2 %) that are composed by triglycerides (85 %) and diglycerides.

Processing significantly increased fat content in whole

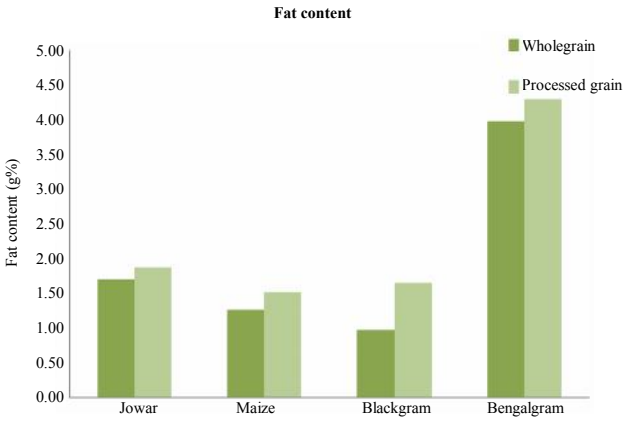

Fig. 2. Fat content of selected food grains

sorghum for both varieties and lower values were compared with recommended values are the same. The influence of processing on the quality of lipids in some grains was reported to increase due to hydrolysis of tryacilglycerols into free fatty acids and accelerated the formation of hydro peroxides and secondary oxidation products (Ohlsson, 1994).

The fat content of whole maize was 1.25 g per cent and maize processed (flour) was 1.51 g per cent. These values were nearly equal to the fat content of maize (3.6 g %) reported by Gopalan *et al*. (2004). FAO/IAEA (2007) stated that the fat content of maize grain (whole) was 4.5 g per cent. However, value in the present study whole and processed grain was lower than the values reported in the above study. This may be due to difference in varieties studied at the stage of at which the grain were harvested.

For blackgram, fat content was 0.98 g per cent and 1.64 g per cent in whole and processed grain. It was 3.97 g per cent and 4.30 g per cent for whole and processed bengalgram, respectively. These values were nearly co-relation with the recommended values given by Gopalan *et al*. (2004).

From the Table 1, it was clearly depicted that the processed grains has more fat than that of whole grains. Critical difference observed for fat was 0.2465. Whereas for maize, blackgram and bengalgram grain samples were observed to be statistically significant at 5 per cent level except in jowar as not statistically significant at 5 per cent level.

Protein content:

Protein content of all the grains observed is given in Table 1 and Fig. 3. For jowar whole protein content was 8.88 g per cent and jowar processed (boiled) was 8.95 g per cent. These values were comparable with the protein content of jowar (10.4 g %) as reported by Gopalan *et al*. (2004). In a study Saldivar *et al.* (1995) reported a range of jowar was 9.0 to 14.0 g per cent. The results of the present investigation also confirmed with the same. Maize (whole) protein content of was 7.77 g per cent and maize processed was 8.17g per cent. These values were comparable with the protein content of maize (9.20 g %) reported by FAO/IAEA (2007). Regarding protein content of blackgram whole was 21.82 g per cent and blackgram processed was 23.887 g per cent. The same was with bengalgram whole which was 23.25 g per cent and bengalgram processed (23.10 g %). These values were comparable to the protein content of blackgram (24.0 g %) and bengalgram (24.0 g %) reported by Gopalan *et al*. (2004).

Gopalan *et al.* (2004) reported that cereals were moderate sources of protein and pulses were rich source of protein. In general pulses contain high protein content than cereals. In the present study also the same trend was observed.

From statistical analysis the critical difference obtained for protein was 0.6926. Protein content of all the cereal grain samples were observed to be less than CD value and more than CD value for pulses. Hence, it can be said that there existed a statistically significant at 5 per cent level between all the pulse grain samples.

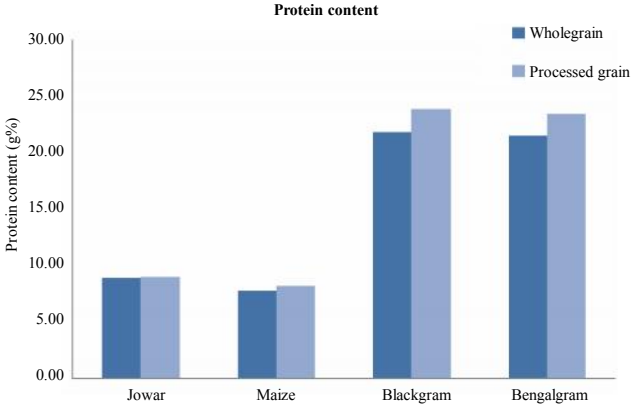

Fig. 3. Protein content of selected food grains

Ash content:

The ash content of selected cereals and pulses was analyzed by AOAC (1990) method. The results are given in Table 1 and Fig. 4. The ash content of jowar (whole) was 1.50 mg per cent and processed jowar was 1.65 g per cent. These values were comparable to the ash content of jowar (1.60 mg %) reported by Gopalan *et al*. (2004). The ash content was higher in processed grain than whole grains. It was reported that the mineral composition and content of the sorghum grain largely depends on the availability of soil nutrients (Polycarpe, 2006).

The ash content of maize (whole) was 1.30 mg per cent and processed maize (flour) was 1.64 g per cent. These values were comparable with the ash content of maize (1.20 mg %) reported by FAO/IAEA (2007). The ash content of whole blackgram was 3.69 mg per cent and processed blackgram (dehulled) was 4.30 g per cent. The ash content of whole bengalgram was 3.0 mg per cent and processed bengalgram was 3.78g per cent. For both blackgram and bengalgram samples ash content values were comparable with the recommended values given by Gopalan *et al*. (2004) 3.2 g per cent and 3.0 g per cent, respectively.

Finally, it was clearly depicted that the ash content of the whole grains was greater than the processed grains. The critical difference obtained for ash was 0.1498. Hence, it could be concluded that there existed a statistically significant difference at 5 per cent level in the ash content of processed grains compared with whole grains of maize, bengalgram and blackgram. However, statistically significant difference at 5 per cent level in the ash content of processed grains compared with whole grains did not exist with jowar.

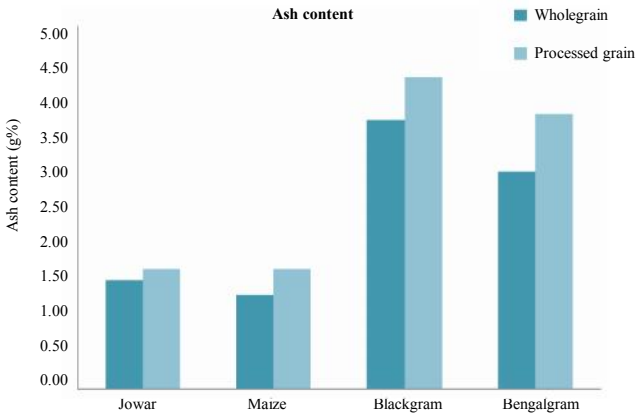

Fig. 4. Ash content of selected food grains

Fibre content:

Fibre content of selected grains was observed and obtained result is given in Table1 and Fig. 5. The fibre content was 1.30 g per cent, 2.68 g per cent, 2.81g per cent and 2.68 g per cent in whole jowar, maize, blackgram and bengalgram, respectively. The same 0.95 g per cent, 1.97 g per cent, 0.78 g per cent and 1.85 g per cent was in processed jowar, maize, blackgram and bengalgram, respectively. These values were comparable with the fibre content of jowar (1.60 g %), maize (2.8 g %) blackgram processed (0.90 g %) and bengalgram dhal (1.2 g %) reported by Gopalan *et al*. (2004).

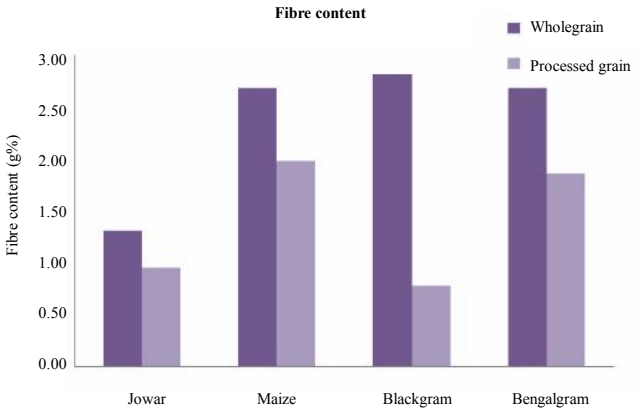

Fig. 5. Fibre content of selected food grains

Cereal bran is a rich and common source of dietary fiber as well as various vitamins and minerals. Bran from cereals like rice, oats, sorghum and barley are highly effective sources of dietary fiber in animal and human studies (Rooney and Murthy, 1987).

Results of fibre content showed that whole grains contained high fibre content than processed grain. Critical difference obtained for fibre was 0.205. Hence, it can be said that statistically significant difference at 5 per cent level between all the selected four samples. Gopalan *et al.* (2004) observed that whole grains contained high fibre than processed grains, because whole grain contained high bran content.

Carbohydrate content:

Carbohydrate content of grains was analyzed by difference method. The carbohydrate content of the selected grains is given in Table 1 and Fig. 6. The carbohydrate content of jowar (whole) was 76.6 g per cent and dehulled jowar (processed) was 75.9 g per cnt. Whole sorghum grain generally contained carbohydrate (75-79%) as the major component. These carbohydrate fractions are mainly located within the protein bodies and protein matrix of the starchy endosperm. (Saldivar *et al.*, 1995).

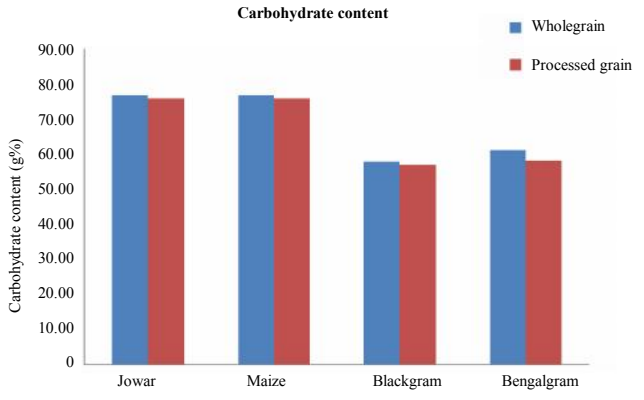

Fig. 6. Carbohydrate content of selected food grains

Carbohydrate content was 76.63 g per cent, 57.86 g per cent and 61.13 g per cent in whole jowar, maize, blackgram and bengalgram, respectively. The same was 75.89 g per cent, 56.78 g per cent and 58.14 g per cent in processed maize, blackgram and bengalgram, respectively. These values were coinsided with the carbohydrate content of maize (66.2 g%), blackgram whole (59.6g %), bengalgram whole (60.9 g %) and bengalgram processed (59.8 g %) reported by Gopalan *et al.* (2004).

Finally, carbohydrate content revealed that the cereals had higher carbohydrate content than pulses. The critical difference obtained for carbohydrate was 1.0976. Statistically significant difference was not observed in carbohydrate content of whole and processed samples with regard to maize, jowar and blackgram except bengalgram which was statistically significant at 5 per cent level.

Pre-processing techniques like germination and dehulling of legumes enhanced the nutritional quality and bio-availability and digestibility of nutrients. Post-processing technique like pressure cooking was found to be most effective, in retention of the nutrients in both blackgram and bengalgram.

Conclusion:

Statistically significant difference at 5 per cent level was observed with regard to all the nutrients analyzed between the whole and the processed samples, except protein in jowar and maize, fat and ash in jowar and carbohydrate in jowar, maize and blackgram, which were statistically not significant. Finally concluded that whole grain samples contain lower content of moisture, protein, fat, ash and carbohydrate than processed grains. Whole grains contain greater fibre content than processed grains.

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