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Research Paper

Effect of processing methods on phytic acid, total iron and iron bioavailability of cowpea

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ABSTRACT : Cowpea is a oval creamy white bran with a black eye, soft textured, an excellent source of fibre and folate and a good source of iron. One of the main drawbacks that limits the nutritional quality of legumes is the presence of anti-nutritional factors. The present study was undertaken to investigate the effects of processing methods such as soaking, germination, fermentation, wet heating on phytic acid, total iron, iron bioavailability of cowpea. 100g. sample was weighed for each processing technique separately as soaking and germination for 24,48,72 hrs. fermentation and wet heating (10,15,20 min.). Samples were analyzed in triplicate for phytic acid, total iron and iron bioavailability using standard procedure. Results showed that soaking for 24 ,48,72 hrs. decreased phytic acid and increased total iron and iron bioavailability. It can be concluded that germination for 24 hrs. was better than 48 hrs. as phytic acid increased during 48 hrs. germination and T_1(24hr.) germination was more effective than other as it increased total iron and iron bioavailability. 20 mints wet heating decreased not only phytic acid but also total iron and its bioavailability as compared to control, so 20 min. cooking is not suitable for cowpea,10 mints cooking is good as it maintains both iron and its bioavailability. Fermentation can be suggested as a best method of processing as it decreased the phytic acid more than other methods and increased total iron and its bioavailability, respectively.

KEY WORDS : Bioavailability, Anti-nutritional factors, Bioavailability, Cowpea

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Cowpea is one of the most important food legume crops in the semi-arid tropics covering Asia, Africa, southern Europe and south America. Cowpea is a oval creamy white bran with a black eye, soft textured, an excellent sources of fibre and folate and a good source of iron. One of the main drawbacks that limits the nutritional quality of legumes is the presence of anti-nutritional factors. Lynch *et al*. (1984) report that bioavailability of iron contained in legume is very low because it contains appreciable quantities of phytate and tannins. Phytic acid is widely distributed in legume seed and it accounts for about 78 per cent of the total phosphorus in pulses. Phytic acid in food of plant origin forms a complex with dietary minerals such as calcium, zinc, iron, magnesium and make them biologically unavailable for absorption. Allen and Ahluwalia (1997) reported that the main problem with diets based on non-animal staples is that they usually contain large amounts of phytic acid, the most potent inhibitor of non heme iron absorption. Low absorption of minerals has been associated with a high intake of phytic acid and dietary fibre. The present study was undertaken to investigate the effects of processing methods such as soaking, germination, fermentation, wet heating on phytic acid, total iron, iron bioavailability of cowpea.

RESEARCH METHODS

The present study was done in "chemical Laboratory", Dept. of Food and Nutrition, College of Home Science, Maharana Pratap University of. Agriculture and Technology, Udaipur (Rajasthan). Sample was collected from food Lab., Department of Food and Nutrition, College of Home Science, Maharana Pratap University of. Agriculture and Technology, Udaipur (Rajasthan). 100g sample was weighed for each

processing technique separately as soaking, germination, fermentation and wet processing. Weighing balance was used for this purpose.

In soaking 100g sample were taken and soaked in distilled water for 24, 48,72 hours , then removed water and ground in mixer for making paste. For moisture free dried in oven for at 50 ^{0}C. For germination 100 g seeds were soaked in distilled water for 12 hours at room temperature and germinated for 24,48 and 72 hours. Water removed and ground in mixer for making paste. For moisture free dried in oven for at 50 ^{0}C.

Fermentation was done by soaking sample in 1:2 ratio in distilled water for 16 hours then soaked samples were ground a paste in a blender. The paste was thoroughly mixed with 1.5 per cent natural curd sample containing lactic acid bacteria and fermented for 12 ,16, 20 hours. The fermented paste was freeze dried and ground to fine powder. In wet heating sample was wet heated to water ratio 1:2 for 10,15,20 min. in pressure cooking. After it, the content were freeze dried and ground to a fine powder.

Nutrient content analysis :

Samples were analyzed in triplicate for phytic acid , total iron and iron bioavailability. Phytate form insoluble complex with iron, zinc, calcium and magnesium, thus, made them unavailable to body. Estimation of phytate is important to assess the nutritive value of food. Ferric chloride reacts with phytic acid and precipitate as insoluble ferric phytate. Iron reacts with dipyridyl regent and gives pink colour. The intensity of the colour develops is directly proportional to the concentration of iron present in the sample. Bio-availability is viewed as the portion of iron present in food stuff which is absorbed and utilized by the body. It is the actual amount of iron available to the body after digestion and absorption of food item.

■ RESEARCH FINDINGS AND DISCUSSION

The present study was done leading to an objective to know the effect of processing on phytic acid, total iron and iron bioavailability of cowpea. The results have been discussed in the following heads:

Soaking :

Table 1 shows that as the time of soaking increased phytic acid decreased gradually 4.47(C), 4.33 (T_1), 4.28 (T_2) and 4.24 (T_3) per cent. While total iron increased to 8.8, 8.9, 9.2 mg. as compared to control 8.6 mg. The same effect was observed on iron bioavailability, it increased to 7.3, 7.7, 7.9 mg, respectively as compared to control (Fig. 1).

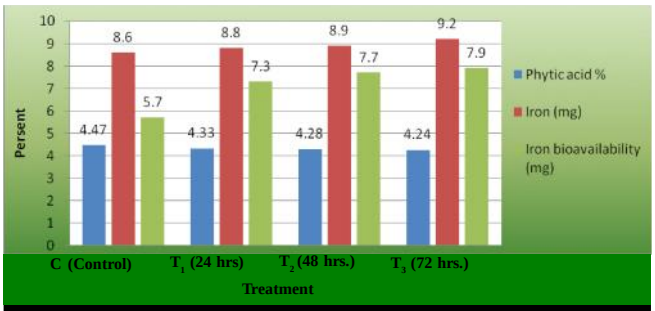

Fig. 1: Effect of soaking on phytic acid, iron, iron bioavailabitity of cowpea as compared to control

According to Anthony and Babatunde (1984) soaking for three days decreased T_I activity by a mean of 31.2 per cent, hemagglutinin activity by 19.0 per cent, tannic acid by 13.4 per cent and phytic acid by 24.4 per cent. Sandberg and Svanberg (1991) reported that soaking flour for 24 hours increased the amount of soluble iron by up to tenfold .

Germination :

Table 2 shows that when treatment 1,2,3 were compared to control, phytic acid decreased during 24 hrs, 3.09 per cent and increased in 48 hrs,4.29 per cent and again decreased 3.74 per cent, respectively. But it was less increased than control, 4.47 per cent. While total iron in treatment 1,2,3 increased,

Table 1: Effect of soaking on phytic acid, iron, iron bioavailability of cowpea as compared to control

Treatments	Phytic acid %	Iron (mg)	Iron bioavailability (mg)
C (Control)	4.47	8.6	5.7
T_1 (24hrs).	4.33	8.8	7.3
T_2 (48 hrs.)	4.28	8.9	7.7
T_3 (72 hrs.)	4.24	9.2	7.9

Table 2 : Effect of germination on phytic acid, iron,iron bioavailability of cowpea as compared to control

Time	Phytic acid %	Iron(mg)	Iron bioavailability (mg)
C (Control)	4.47	8.6	5.7
T_1 (24 hrs.)	3.09	8.8	6.8
T_2 (48 hrs)	4.29	8.9	7.5
T_3 (72 hrs)	3.74	9.0	8.1

respectively 8.8,8.9,9 per cent as compared to control and bioavailability also increased gradually in all treatments (Fig. 2).

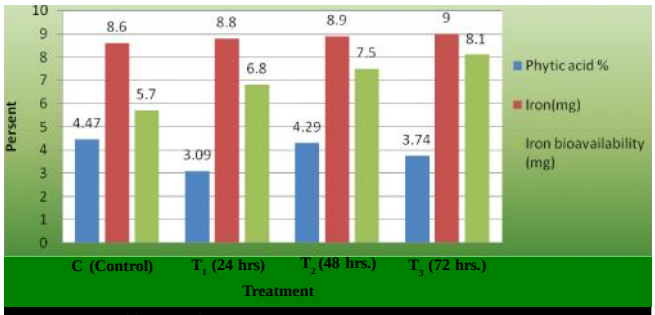

Fig. 2 : Effect of germination on phytic acid, iron, iron bioavailabitity of cowpea as compared to control

Rehinan *et al*.(2004) reported that germination caused significant ($p<0.05$) increase in protein, thiamin, *in vitro* iron and calcium bioavailability and *in vitro* starch and protein digestibility content of all legumes samples. Phytic acid and tannin were reduced by 18-21per cent and 20-38 per cent, respectively, on germination and more reduction was observes in dehulled oven germinated samples. Sandberg and Svanberg (1991) and Camacho *et al*. (1992) reported that the amount of certain vitamins, including riboflavin,B-6 and vitamin C increased during germination, as well as the bioavailability of calcium, iron and zinc.

Fermantation :

Table 3 shows that fermentation decreased phytic acid gradually in treatments, 4.33 and 4.04, per cent, respectively as compared to control(4.47 per cent).Total iron content increased up to 8.9 mg. in 16 hrs. as compared to control (8.6 mg). Iron bioavailability also increased during all the treatments up to 7.8 mg as compared to control 5.7 mg (Fig. 3).

Mensah *et al*. (1996) reported that fermentation can be spontaneous (using the micro-organisms that are naturally present in food), or started with an inoculation. Fermentation improves the bioavailability of minerals, such as iron and zinc, as a result of phytic acid hydrolysis. Sandberg and Svanberg (1991) reported that combining fermentation, soaking and germination techniques is also highly efficient in activating endogenous phytase enzymes to degrade phytic acid and to reduce,to some extent, the amount of polyphenols that inhibit nonheme iron absorption .

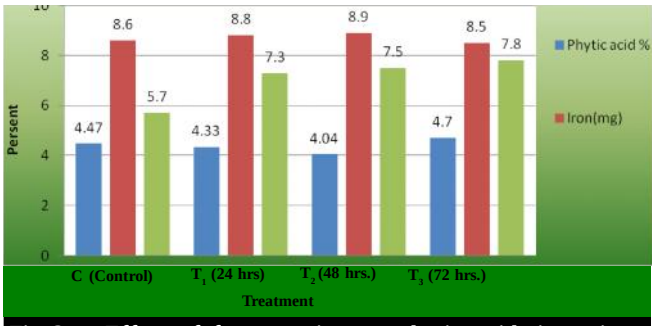

Fig. 3 : Effect of fermentation on phytic acid, iron, iron bioavailabitity of cowpea as compared to control

Wet heating :

Table 4 shows that wet heating gradually decreased phytic acid 4.22, 4.8, 4.02 per cent as compared to control but

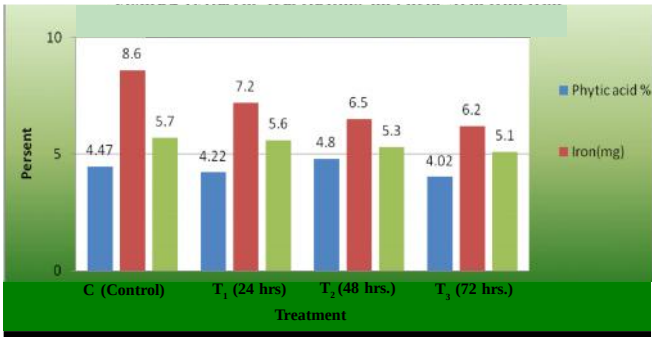

Fig. 4: Effect of wet heating on phytic acid, iron, iron bioavailabitity of cowpea as compared to control

Table 3 : Effect of fermentation on phytic acid, iron, iron bioavailability of cowpea as compared to control

Treatments	Phytic acid %	Iron (mg)	Iron bioavailability (mg)
C (Control)	4.47	8.6	5.7
T_1 (12 hrs)	4.33	8.8	7.3
T_2 (16hrs)	4.04	8.9	7.5
T_3 (20 hrs)	4.7	8.5	7.8

Table 4 : Effect of wet heating on phytic acid, iron, iron bioavailability of cowpea as compared to control

Treatments	Phytic acid %	Iron(mg)	Iron bioavailability (mg)
C (Control)	4.47	8.6	5.7
10 mint	4.22	7.2	5.6
15 mint.	4.8	6.5	5.3
20 mint.	4.02	6.2	5.1

it also reduced iron up to 6.2 mg., when compared to control (8.6 mg),besides this bioavailability of iron also decreased as increase in time of cooking.T_3(20 min.) shows highest loss of iron, 6.2 mg and bioavailability 5.1 mg. (Fig. 4) .

Anthony *et al.* (1984) reported that trypsin inhibitor and hemagglutinin activities were completely eliminated by cooking and autoclaving, while tannic acid and phytic acid contents were only partly affected.

Conclusion :

The present study was done to know the effect of various processing methods on phytic acid, iron and iron bioavailability of cowpea. Results showed that soaking for 24 hrs, 48 hrs,72 hrs, respectively decreased phytic acid and increased total iron and iron bioavailability(Table1). Egounlety and Aworh (2001) reported that there was increasing in time of soaking and germination reduced phytic acid, so seeds should be soaked before using. Soaking the beans for 12–14 h had no effect on the level of trypsin inhibitor of the beans while it increased the phytic acid content to 1.7 per cent in soybean and to 0.8 per cent and 0.7 per cent in ground bean and cowpea. It can be concluded that germination for 24 hrs. is better than 48 hrs as the results showed that phytic acid increased during 48 hrs germination and T_1(24hrs) was more effective than other as it increased total iron and iron bioavailability (Table 2).

Fermentation can be suggested as a best method of processing as it decreased phytic acid more than other methods and increased total iron and its bioavailability, respectively (Table 3). 20 min wet heating decreased not only phytic acid but also total iron and its bioavailability as compared to control. So 20 min cooking is not suitable for cowpea,10 mint cooking is good as it maintains both iron and its bioavailability (Table 4).

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