

Effect of pre-milling processing techniques on pearl millet grains with special reference to *in-vitro* iron availability

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ABSTRACT

Pre-milling processing has an effect on both nutritional composition and its *in-vitro* availability. In the present study an attempt was made to find out the effect of different pre-milling processing on the *in-vitro* iron availability. Pearl millet grains were subjected to processing technique viz. acid treatment (2 hours, 12 hours, 18 hours and 24 hours), dry heat treatment (30 minutes, 60 minutes, 90 minutes and 120 minutes), blanching treatment (30 seconds, 60 seconds and 90 seconds), and malting treatment to find out the *in-vitro* iron availability. Iron content in raw pearl millet was 11.93 mg/100gm. After treatment the total iron content was reduced in all the treatments. The *in vitro* iron availability was found to be higher in all the treatments as compared to raw pearl millet. *In vitro* iron content was noted maximum after dry heat treatment for 120 minutes (i.e. 3.58 mg/100gm) and minimum for 24 hour acid treatment (i.e. 2.39 mg/100gm). Hence the present study indicates that the pre-milling processing may reduce the total iron content but it increases the *in vitro* iron availability.

Key words: Anti-nutritional Factors, *In-vitro*, Pre-milling, Processing, Nutrients.

INTRODUCTION

Almost all foods are processed in some way before consumption (Monteiro, 2009). The main reasons of processing are to eliminate micro-organisms (which may cause disease) and to extend shelf life (Smith and Hui, 2004). Pearl millet is nutritionally comparable and even superior to many cereals and is known as 'nutri-cereal' (Sehgal and Kwatra, 2006). Pearl millet can be stored for longer period without substantial quality alteration if the kernel remains intact (Kaced *et. al.*, 1984; Kachare and Chavan, 1992) but once the grain is decorticated and ground the quality of meal deteriorates rapidly. Pearl millet is used in preparation of conventional foods such as porridge, *roti* or *bhakhri* (stiff *roti*), made from either coarsely or finely milled flour. But the major constraint is that the flour becomes rancid within a few days after milling. Both hydrolytic and oxidative changes are reported in the lipid of the flour, resulting in release of free fatty acids and formation of peroxide, causing rancidity and bitterness. (Kaced *et. al.*, 1984). To overcome this, the pearl millet grains are subjected to pre-milling processing like blanching, malting, popping and dry heat treatment etc. before product development, which produces flour with longer shelf life (Singh and Goyal, 2005). Minerals also get affected by various treatments during processing (Karmas and Harris, 1988). Thus present investigation was

undertaken to find out the effect of various pre-milling processing techniques on total iron content (TIC), *in-vitro* iron availability, polyphenols and free fatty acids.

MATERIALS AND METHODS

Pearl millet was purchased in a single lot from the local market of Udaipur city. The pearl millet grains were cleaned and made free from dirt and other impurities. The pearl millet grains were subjected to pre-milling processing viz. acid treatment (AT) by soaking in 0.2N HCl solution for 2 hours, 12 hours, 18 hours and 24 hours (Pawar and Parlikar 1990, Poonam 2002) and Dry heat treatment (DHT) for different time duration, i.e., 30 minutes, 60 minutes, 90 minutes and 120 minutes, blanching treatment (BT) for different duration that is 30 seconds, 60 seconds, and 90 seconds (Bhati and Goyal, 2007) and Malting treatment (MT) (Rekha, 1997). The details of all the processing techniques are shown in Figure 1.

All the treated samples and control were powdered in an electric grinder, packed in polythene bag and kept in air tight container for the estimation. Each treated sample was analysed for total iron, *in-vitro* iron by the standard method suggested by (NIN, 2003). Free fatty acids and polyphenols were also determined by standard methods suggested by AOAC (2003) and Singh and Jambunathan (1981) respectively.

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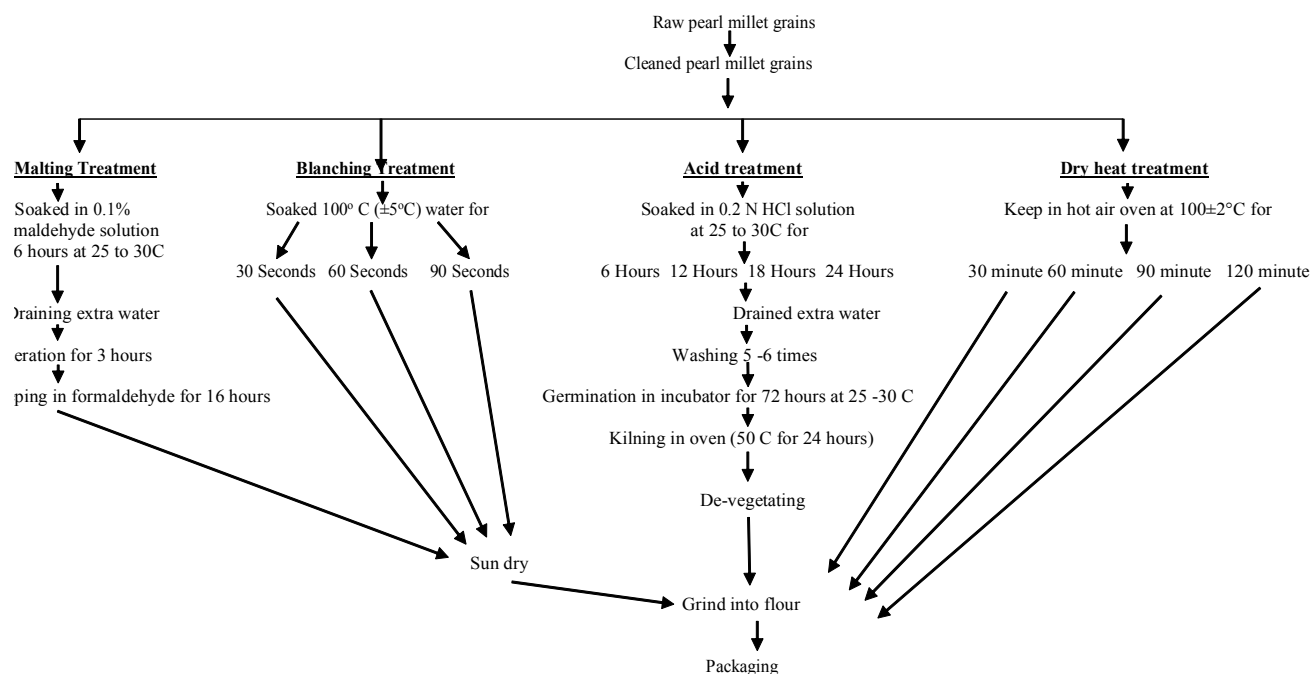


FIG1: Flow Chart showing different pre-milling processing techniques of Pearl millet grains

RESULTS AND DISCUSSION

The TIC in raw pearl millet noted was 11.93 mg/100g (Table 1). Wide variations were noted with respect to various treatments. It was observed that maximum iron was lost in 24 hours-AT. These results show that as the time of AT increases the losses of iron increases. Results reveals that after all the pre-milling processing the TIC was reduced. The minimum losses were noted in 120 minute-DHT followed by 30 seconds-BT, 90 minute-DHT and 60 seconds-BT. Mineral contents, especially phosphorus, calcium, and iron, were reduced with the increase in period of treatment of pearl millet (Arora *et. al.*, 2003). The reason behind this may be leaching or obliteration of minerals due to soaking or heating. The AT, BT, and MT improves the colour of the grains whereas due to DHT the colour of the grains grew darker.

The *in vitro* iron availability increased significantly after all the pre-milling processing of pearl millet grains as compared to the raw ones (Figure: 2). The iron bio availability was noted maximum in 120 minute-DHT (63.47%) followed by 90 seconds-BT (50.23 %), 18 hour-AT (37.44 %) and 90 minute- DHT (35.62%).

The present study showed that all the treatments reduced the polyphenols content from pearl millet. The highest reduction in polyphenolic compound was noted after MT (55.10 %) whereas the minimum loss of polyphenol was noted in 30 minutes- DHT (Fig.3). Polyphenols occur mostly in pericarp of seed. In a study Nithya *et. al.*, (2007) observed a significant variation with respect to anti-nutritional factors and nutritional compounds in different processing treatments. The effect of various pre-milling processing on the proximate

TABLE 1: Content of iron, *in-vitro* iron, polyphenol content and Free Fatty Acids in various treatment.

Treatment	Iron (mg/100g)	<i>In-vitro</i> Iron (mg/100g)	Polyphenol (mg/100g)	Free Fatty Acid (mg/100g)
Raw	11.93	2.19	675.33	44.56
AT 2	8.44	2.73	631.27	27.67
AT12	7.19	2.91	593.33	21.14
AT 18	6.41	3.01	571.89	16.71
AT 24	4.39	2.39	541.68	11.6
DHT30	10.33	2.56	658.63	33.023
DHT 60	10.91	2.65	641.23	28.15
DHT 90	11.27	2.97	586.78	21.84
DHT 120	11.67	3.58	477.93	16.23
BT 30	11.57	2.49	628.69	21.09
BT 60	11.13	2.89	605.81	28.37
BT 90	10.98	3.29	579.36	20.57
MT	7.8	2.61	303.21	15.04

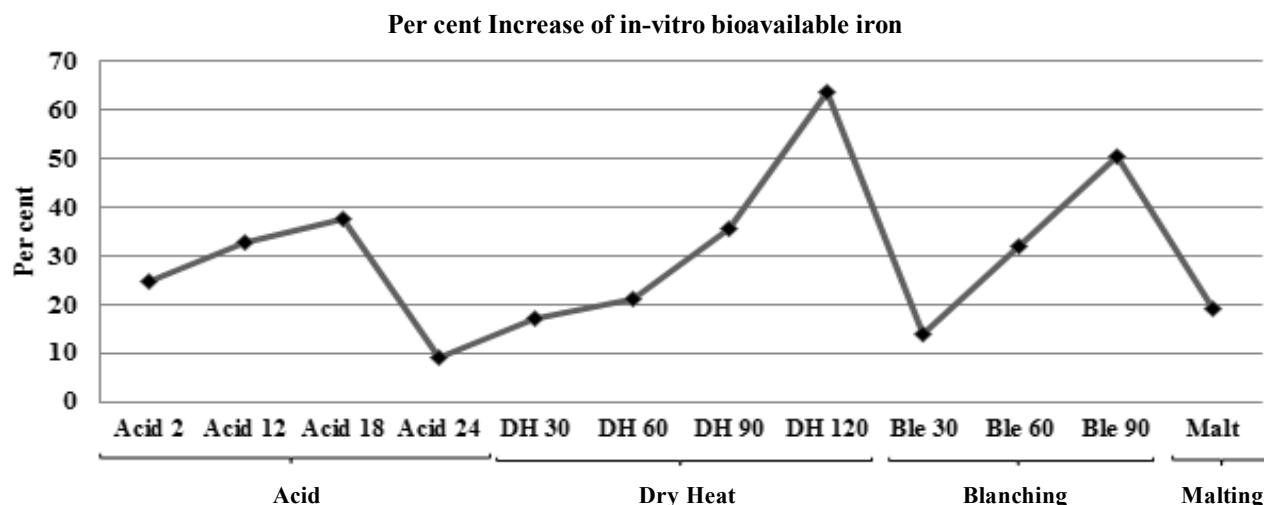


FIG 2: Effect of pre milling processing on *in-vitro* bio-available iron in pearl millet

composition, anti-nutritional factors and functional properties of pearl millet had varied effects on mineral composition and it also helps in reduction anti-nutritional factors (Sade, 2009; Archana, *et. al.*, 1998). It also improved the protein digestibility and starch digestibility to a significant extent (Chowdhury and Punia, 1997). Various processing techniques like malting, blanching, sprouting, dry heat treatment, fermentation and soaking *etc.* have been developed to increase the shelf life of flour, to improve the colour of grains and to enhance the bio availability of several nutrients like protein, starch and minerals. It is evident that processing of pearl millet may lower the anti-nutritional factors and improve the nutritive value of pearl millet for its diversified uses (Khairwal *et. al.*, 2004).

Free fatty acid in pearl millet was found to be reduced after the all the pre-milling processing treatment

(Fig.4). The maximum reduction of free fatty acid was noted for the 24 hour AT (73.97 %) followed through MT (66.25 %), 120 minutes DHT (63.58%) and 18 hours AT (62.50%). In present study it was observed that all the pre-milling treatments reduce free fatty acid content from the pearl millet grains. Free fatty acids content reduces the shelf life of the pearl millet flour and produces an off flavour. Thus through these pre-milling processing techniques free fatty acid content could be reduced from the grain and could increase the shelf life of pearl millet grains. Singh and Goyal (2005) reported significant increase in the free fatty acid content of pearl millet based products. Increase in the free fatty acid content in the meals obtained from pearl millet grains was found to three to four folds lower than in untreated grains. Heating of grain for 120 minutes has been found to be most effective (Kadlag *et al.*, 1995). The development of fatty

Per cent reduction of polyphenol after pre-milling processing of pearl millet

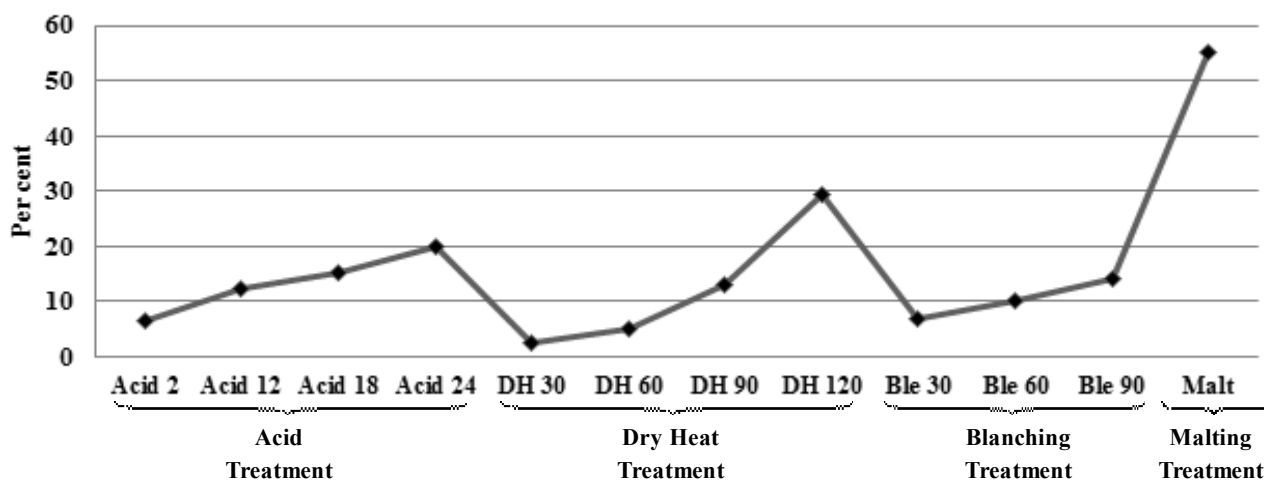


FIG 3: Effect of pre milling processing on polyphenol content in pearl millet grains

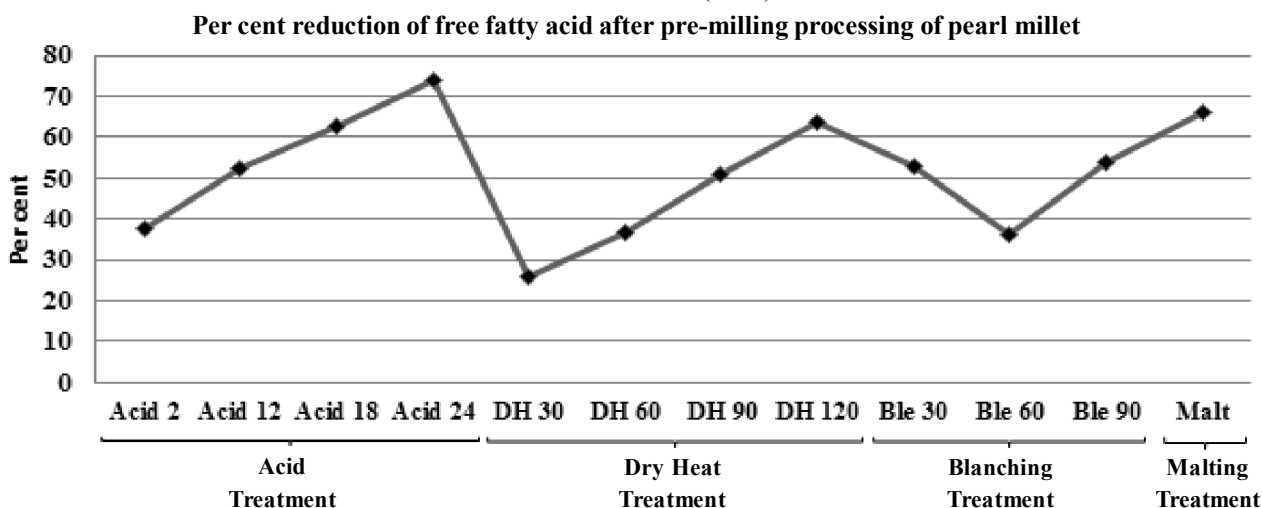


FIG 4: Effect of pre milling processing on free fatty acid content

acids on malting occurs mainly due to the action of lipase (Pelembé *et.al.*, 2003). Kadlag *et.al.*, (1995) found that blanching for 10 seconds enhanced shelf life by 25 days as well as reduced free fatty acids content.

CONCLUSION

Results from the study reveals that pre-milling processing reduces the iron content compared to the raw pearl millet grains (11.93 mg/100gm). Maximum decrease in iron content was recorded in acid treatments, (i.e. 8.44 mg/100g to 4.39 mg/100gm). The duration of acid treatment

was proportion to the loss of iron. This is due to leaching of minerals as these are present in pericarp of the seeds of pearl millet. The maximum *in vitro* iron was noted in 120 minute dry heat treatment followed by 90 seconds blanching treatment. However after 120 minute dry heat treatment grains became dark and had cooked flavor. Therefore it can be concluded that 90 second blanching treatment may be used for the product development because of high *in-vitro* iron 3.29 mg/100grams, great reduction in free fatty acid content (20.57) and for improving the color.

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