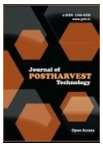

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RESEARCHARTICLE

Effect of soaking, germination and drying on anti-nutrients and minerals present in horsegram

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ABSTRACT

Horse gram (*Macrotyloma uniflorum*) is legume, which has a place with family Fabaceace. It is a potential grain legume having excellent wholesome quality and least expensive source of protein. It is rich in calcium and iron. Most extreme use of horse gram is missing because of the presence of anti-nutritional factors like tannin and phytic acid which interferes with the bioavailability of nutrients present in horse gram. The anti-nutritional factors, mineral content of raw and germinated horse gram were evaluated after giving varied pretreatments of soaking, germination and drying. Treatment of 6hrs soaking, 72hrs germination and drying at 70˚C gave maximum decrease in the anti-nutritional factors i.e. tannin and phytic acid (24.77% and 39.66%), respectively. At the same time mineral content was reduced i.e. calcium and iron content (31.68% and 20.68%), respectively. It can be observed that all this pretreatment played vital role in reduction in both anti-nutritional factors and mineral content.

Keywords: Horse gram, soaking, germination, drying

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INTRODUCTION

Horse gram has a place with family Fabaceae is a potential legume having excellent dietary and medicinal properties with better atmosphere versatility to adjust difficult climatic conditions. It is one of the most significant unexploited food legume being developed everywhere throughout the world (Bhartiya et al., 2015). In India, horse gram is cultivated as crop impart about 0.33% of total food grain production (Ramteke et al., 2016). Most extreme use of horse gram is missing because of the components like tannin, trypsin inhibitor, phytic acid which interfere with the bioavailability of supplements present in horse gram (Haripriya et al., 2017). The procedure of germination is seen as reducing the degree of polyphenols, oxalic acid and phytic acid present in the horse gram. Poor functional properties of horse gram seeds are major limitations to utilize its flour in combination flours. Use of horse gram can be maximized through an understanding of its physical and chemical compounds properties and by the implementation of various processing strategies to encourage the improvement of financially suitable

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alternative products. Nutritional value and consumption of horse gram could be improved by processing it into new product (Jain et al., 2012).

MATERIALS AND METHODS

Horse gram (variety AK 42) seeds were procured from whole sale vendor, Loni kalbhor, Pune in a bulk amount to ensure uniformity of the raw material all throughout the examination. Seeds were cleaned manually to remove the mud particles and some extraneous matter present alongside horse gram. Seeds were additionally washed with water and soaked in water (1:5 w/v) for 6, 12 and 18hrs at room temperature. Later, the same samples were used further for germination process. The excess water was drained and the process of germination was carried out for 24, 48 and 72 h respectively at room temperature. Germinated samples were dried in a cabinet drier (Labfit, India) at 50, 60 and 70 ˚C till the accomplishment of consistent moisture content. Proximate analysis of raw horse gram was carried out by (Ranganna, 2011) i.e. moisture content by hot air oven method, fat content by extracting sample with petroleum ether ,Protein content by micro-kjeldhal method, fiber by using FibroTRON, ash content by muffle furnace, carbohydrate by difference method. The calcium and iron were estimated by titration. Tannin and phytic acid were estimated by (Thimmaiah, 2016). Later on analysis was carried on for germinated samples in context to anti-nutritional factors.

RESULTS AND DISCUSSION

Effect on anti-nutritional factors

The tannin content of raw horse gram seeds was found to be 319mg/100g. Table 1 depicts percent reduction of tannin after soaking, germination and drying at different treatments. It was found that 6h soaking, 72h germination and 70˚C drying having maximum reduction i.e. 24.77% in tannin content. Germination procedure triggered the enzymatic movement of seeds, which further breaks the starches, proteins and fats into less complex structures. The procedure of germination diminished the amount of polyphenols, oxalic acid, tannin and phytic acid present in the horse gram seeds (Vandarkuzhali et al., 2006). Tannin content of horse gram display a decrease with an increase in time of soaking and germination period (Handa et al., 2017; Moktan and Ojha, 2016). The reduction in tannin content is mostly because of the way that these compounds highly present in seed coats and tannins are water soluble (Kumar et al., 1979). Polyphenolase activity during germination causes loss of tannins content in grains (Reddy et al., 1985). Statistically significant effect was observed for soaking, germination, drying, interaction of Soaking- Germination, Soaking- Drying, Germination- Drying and Soaking- Germination- Drying on Percent reduction in iron content at 5 % significance level as their FCAL was more than FTAB.

Raw horse gram contained 10.26mg/g of phytic acid. Table 2 depicts percent reduction of phytic acid content after soaking, germination and drying. It concludes that 6h soaking, 72h germination and 70˚C drying having maximum reduction i.e. 39.66% in phytic acid content. Phytic acid content of horse gram showed a diminishing with increase in soaking time. During sprouting, phytic acid, a phosphate reserve corrupts because of the activity of phytase which is used by growing seed (Mamudu et al., 2005). Phytase activity during germination, resulting in hydrolysis of phytate phosphorus, gave the reduction in phytic acid. The liberated phosphorus is possibly shipped to the embryo for next synthesis of organic phosphates. The rise in phytase action during germination could be because of activation of the pre-existing enzyme. Simultaneously inorganic phosphorus was liberated because of breakdown of phytic acid (Kim et al., 1984). This has been attributed to a raise of phytase activities. In fact, this enzyme makes the phytates resolvable and discharges dissolvable minerals and protein (Khattak et al., 2007). The soaking, germination and drying out of horse gram resulted in a decrease in tannin and phytic acid content. Statistically

significant effect was observed for soaking, germination, drying, interaction of Soaking- Germination, Soaking- Drying and Soaking- Germination- Drying on Percent reduction in phytic acid content at 5 % significance level as their FCAL was more than FTAB. Except for the interaction of Germination- Drying.

Table 1: Tannin content (%) after germination

S	G	D	Reduction (%)	S	G	D	Reduction (%)	S	G	D	Reduction (%)
6	24	50	10.97	12	24	50	28.21	18	24	50	40.75
		60	12.22			60	28.84			60	41.37
		70	12.85			70	29.78			70	42.00
	48	50	18.18		48	50	31.97		48	50	45.45
		60	18.80			60	32.91			60	46.08
		70	19.43			70	33.86			70	47.03
	72	50	22.58		72	50	35.11		72	50	51.73
		60	23.83			60	36.06			60	52.67
		70	24.77			70	36.37			70	53.61

S-Soaking time (h), G- Germination time (h), D- Drying temperature (^{0}C), Reduction- %

Table 2: Phytic acid content (%) after germination

S	G	D	Reduction (%)	S	G	D	Reduction (%)	S	G	D	Reduction (%)
6	24	50	22.22	12	24	50	44.54	18	24	50	53.80
		60	22.61			60	44.73			60	54.09
		70	23.20			70	45.12			70	54.38
	48	50	32.36		48	50	46.97		48	50	56.23
		60	32.56			60	47.07			60	56.82
		70	33.05			70	47.47			70	57.01
	72	50	39.09		72	50	50.20		72	50	58.77
		60	39.28			60	50.49			60	58.96
		70	39.66			70	50.69			70	59.26

S-Soaking time (h), G- Germination time (h), D- Drying temperature (^{0}C), Reduction- %

Effect on mineral contents

The calcium content of raw horse gram seeds was 281mg/100g. The calcium content of soaked, germinated and dehydrated horse gram is shown in Table 3. It was found that 6 h soaking, 24h germination and 50˚C drying resulted minimum reduction i.e. 24.20% and 18 h soaking, 72 h germination and 70˚C drying gave maximum reduction i.e. 55.88% in calcium content. Decrease in calcium content at the time of soaking was observed by (Moktan and ojha, 2015). Decrease in calcium content with prolongation to soaking (6 and 18 h soaking) is because of leaching of the mineral into soaking medium (Lagarda et al.,

2015). The lower ash contents obtained in the germinated samples and their reduction could be due to draining of solid matter in soaking water (Reihaneh and Prakash 2007; Rusydi et al., 2011).The mineral content was also decreased over germination (Sadawarte et al., 2018; Elmaki et al., 2007). The soaking and germination of horse gram resulted in a reduction in calcium content whereas no significant change in calcium content in dehydration variations. Statistically significant effect was observed for soaking, germination, drying, interaction of Soaking- Germination, Soaking- Drying, Germination- Drying and Soaking-Germination- Drying on percent reduction in calcium content at 5 % significance level as their F_{CAL} was more than $F_{TAB.}$

Table 3: Calcium content (% Reduction)

S	G	D	Result (%)	S	G	D	Result (%)	S	G	D	Result (%)
		50	24.20			50	33.46			50	45.20
	24	60	24.56		24	60	33.46		24	60	45.56
		70	24.56			70	34.17			70	46.27
		50	28.47			50	38.08			50	50.18
6	48	60	29.19	12	48	60	38.44	18	48	60	50.54
		70	29.59			70	39.15			70	51.32
		50	30.97			50	41.29			50	55.52
	72	60	31.32		72	60	41.29		72	60	55.88
		70	31.68			70	41.64			70	55.88

S-Soaking time (h), G- Germination time (h), D- Drying temperature (˚C), Result- % calcium reduction

Table 4: Iron content (% Reduction)

S	G	D	Result (%)	S	G	D	Result (%)	S	G	D	Result (%)
		50	17.43			50	22.63			50	25.75
	24	60	17.82		24	60	22.89		24	60	25.88
		70	17.95			70	23.02			70	26.14
6		50	19.25	12		50	23.03	18		50	26.27
	48	60	19.51		48	60	24.06		48	60	26.40
		70	19.77			70	24.19			70	26.40
		50	20.29			50	24.97			50	27.05
	72	60	20.55		72	60	25.23		72	60	27.05
		70	20.68			70	25.23			70	27.31

S-Soaking time (h), G- Germination time (h), D- Drying temperature (℃), Result- % Iron reduction

The iron content of raw horse gram seeds was 7.6mg/100g.The iron content of soaked, germinated and dehydrated horse gram is shown in (Table 4). Results showed that 6 h soaking, 24 h germination and 50˚C drying having minimum reduction i.e.17.43% and 18 soaking, 72 germination and 70˚C drying having maximum reduction i.e. 27.31% in iron content. Significant

decrease in iron and calcium contents found by germination was well documented by Das et al., 1999. Iron content was found to be decreased over germination (Sadawarte et al., 2018). The lower ash contents were obtained in the germinated samples and this reduction could be due to leaching of solid matter in soaking water (Reihaneh and Prakash 2007: Rusydi et al., 2011). Whereas no significant change in iron content in dehydration variations. Statistically significant effect was observed for soaking, germination, drying, interaction of Soaking- Germination, Soaking- Drying, Germination- Drying and Soaking-Germination- Drying on Percent reduction in iron content at 5 % significance level as their F_{CAL} was more than $F_{TAB.}$

CONCLUSION

Horse gram is a least expensive source of protein, rich in calcium and iron. Most extreme use of horse gram is missing because of the anti-nutrients. The procedure of soaking and germination is seen as diminishing the degree of anti-nutrients. Germination procedure triggers the enzymatic movement of growing seeds, which further breaks the starches, proteins and fats into less complex structures. Significant changes induced by soaking and germination would make the horse gram as one of the suitable legume food to be incorporated in the daily diet of all age group people. It was found that 6h soaking, 72h germination and 70˚C drying having maximum reduction i.e. 39.66% in phytic acid content whereas 6h soaking, 72h germination and 70˚C drying having maximum reduction i.e. 24.77% in tannin content. It was also found that 18 h soaking, 72 h germination and 70˚C drying gave maximum reduction i.e. 55.88% in calcium content whereas 6 h soaking, 24 h germination and 50˚C drying having minimum reduction i.e.17.43% and 18 soaking, 72 germination and 70˚C drying having maximum reduction i.e. 27.31% in iron content.

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