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Anti-Nutritional Factors in Finger Millet

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Introduction

Plants commonly synthesize a range of secondary metabolites to protect themselves against herbivores, insects and pathogens or adverse conditions. Millets inherently carry certain anti-nutritional factors to keep the predating insects at bay. Ragi (*Eleusine coracana* Gaertn) does contain anti-nutritional factors, which might reduce the availability of nutrients thereby reducing the productivity performance of the birds [1]. Some of these factors present in ragi include tannins, non-starch polysaccharides-glucans, protease inhibitors, oxalates and phytates, each of which might directly or indirectly affect the digestibility of nutrients.

Tannins

Tannins have been reported to be responsible for decreases in feed intake, growth rate, feed efficiency, net metabolizable energy, and protein digestibility in experimental animals [2]. Tannins have been found to reduce feed intake, impair nutrient digestibility and nitrogen retention thus causing growth depression of poultry [3,4]. Tannins are a group of phenolic non-nitrogenous organic constituents, which are chemically classified into two broad categories viz., hydrolysable and condensed tannins [5]. Condensed tannins on hydrolysis yield flavans, while the former yield gallic acid. Among millets, finger millet is reported to contain high amounts of tannins ranging from 0.04% to 3.74% of catechin equivalents [6]. Ramachandra et al. [7] also reported the tannin content of ragi from 0.04 to 3.47 per cent, with most of the values falling around 0.6 per cent. White grain varieties of finger millet had low levels of tannins (0.05%) compared with the brown and dark-brown varieties (0.61%). Highest amount of tannins (3.42%-3.47%) was found in two African varieties, IE927 and IE929. Hulse et al. [8] and Rao and Deosthale [6] reported high levels of tannins in dark colour varieties, while the tannin content of brown varieties of ragi ranged from 0.35 to 2.40 per cent. The white ragi hardly contained any tannin. Parida et al. [9] also reported that the white grain varieties of ragi had very low phenol and tannin levels when compared with brown varieties.

Protease Inhibitors

The protein inhibitors disrupt the protein digestion by rendering unavailability of the digestive enzymes, trypsin and chymotrypsin. Their presence is characterized by compensating hypertrophy of the pancreas. Shivaraj and Pattabiraman [10] described the presence of an inhibitor in ragi, and it is a single functional protein factor, which is responsible for both amylase inhibitor and trypsin inhibitory activities with two different reactive sites. Chandrashekara et al. [11] reported that millets had considerable varietal differences in the proteinase inhibitor activity and that the finger millet had more anti tryptic activity than antichymotryptic activity. However, Ravindran [12] reported that the chymotrypsin inhibitory unit values obtained for different finger millets were comparable.

Shivaraj et al. [13] isolated two inhibitors from ragi by affinitytechnique and designated them as chymotrypsin inhibitor (CTI) andtrypsin alpha amylase inhibitor (TAI).

Non-Starch Polysaccharides [NSPs]

In addition to Tannins and Protease inhibitors, millets also contain non-starch polysaccharides (betaglucans), phytates, oxalates, etc., each of which might directly or indirectly affect the digestibility of nutrients in millets or millets based diets [1]. Non-starch polysaccharides are defined as polymeric carbohydrates, which differ in composition and structure from amylose and amylopectin [7]. NSPs contain glycosidic bonds other than (1-4) and (1-6) bonds present in starch. The nature of the bond determines their susceptibility to cleavage by avian digestive enzymes. These NSPs have high molecular weight ranging from 8000 to 9000 million. The NSPs in broiler feed could cause growth depression and decreased in feed conversion efficiency.

Ingredient	Total pentosans	Cellulose	Pectins	Total NSPs
Maize	5.37	3.12	1	9.32
Sorghum	2.77	4.21	1.66	9.75
Finger millet	3.31	3.03	1.76	9.4

Table1: The non-starch polysaccharide (NSPs) content of ragi [14].

Wankhede et al. [15] reported pentosan content of ragi as 6.2 to 7.2 per cent, while Malleshi et al. [16] opined that native millets contained more hexoses than pentosans. Kamat and Belavady [17] observed that ragi contained slightly higher levels of total unavailable carbohydrates (18.6%) as compared to wheat (17.3%).

Discussion

Rao and Deosthale [6] have shown reduced tannin content after soaking, roasting, boiling, germination and fermentation. Malting has been shown to decrease tannins up to 54% in brown finger millet [7] and phytic phosphorus up to 58% and 65% in brown and white finger millet respectively [16]. Significant reduction of trypsin inhibitors up to 61.5% was found in roasting followed by pressure cooked ragi.

Conclusion

Finger millet has great potential of providing nutritional security and is well comparable and even superior to many cereals in terms of mineral and micro nutrient contents. The use of finger millet as food has remained only in the area where it is cultivated. In view of anti-nutritional factors observed it has been reported that germination improves the nutritive quality of cereals. Due to the high bulk density of porridge made from cereals, major efforts have been made to promote the use of sprouted millet. Due to enzymatic breakdown of starch to sugars during germination, the viscosity and bulk density of porridge made from sprouted grains are significantly lower. Sprouting has been reported to improve the nutritional quality of seeds by increasing the contents and availability of essential nutrients and lowering the levels of anti-nutrients. Sprouting of finger millet resulted in lowered levels of the anti-nutrients namely tannins, phytates and TIA.

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