Anti-Dietetic Factors in Legumes: A Review

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Abstract **- Legumes are very essential crops cultivated in Asia, Africa, and Caribbean regions for human and animal nutrition. Legumes are good source of protein and dietary fiber in our day-to-day meal. Whoever, a wide variety of antinutritional factors namely raffinose family oligosaccharides (RFO's), Proteinaceous compounds, lectins, neurotoxin, goitrogenic factor, amylase inhibitors, and phytic acid are existing in them. These factors impact the absorption and bioavailability of nutrients by humans and also in animals when utilized as a feed. The feasible methods decrease the anti-nutritional factors are use of enzyme to decrease the concentration, breeding of crop varieties with decrease concentration of antinutritional factors, and through local procedures such as soaking, germination and cooking. Even previously to emergence of science and technology, humans have employed this long-established knowledge to decrease the quantity of antinutritional factors from plant origins. Although, current advances in crop breeding and genetic bring the opportunity to decrease the concentration of these anti-nutritional factors genetically.**

INTRODUCTION

Legumes own a major place in human nutrition and considered as poor man's meat mainly by those who are in growing countries. This is as a result of the cause that legumes are a rich source of protein and slowly digestible carbohydrates. They are extremely significant in human and animal nutrition. Preferably the basic protein need is met by consuming proteins of plant and animal origin. Especially these facts, legumes contain more protein than any other plant protein. They also have special property of preserving and restoring soil fertility. Legumes are a good source of nutrients like starch, protein, vitamins and minerals and also have dominant health protective compounds (antioxidants, phenolic and inositol phosphates). Above mentioned advantageous composition of legume seeds, help to make them a meat replacer for vegetarians and also a component of rational nourishment. They deliver as a low-cost protein to meet the demand of huge section of people. Though, some anti-nutritional factors exist in legume seeds are a main limiting factor for the enlarged use of legumes. This may even lead to health difficulty which could in the end become deadly to humans and animals if taken in huge quantity. Despite the increasing attentiveness regarding cultivation of pulses, the withering in area and production of seeds, and their application is comparatively little (kozlowska et al., 1998). Legumes contain a extensive variation of antinutritional factors for-instance raffinose family oligosaccharides (RFO's), Proteinaceous compound, neurotoxin, lectins, goitrogenic factor, amylase inhibitors, and phytic acid (Main et al., 2000; Preet and Punia, 2000; Enneking, 2011). Food processing procedure plus soaking (Frias, 2000; Vidal-Valverde et al., 2002) decortications, fermentation, germination, cooking and addition of enzymes have been recommended to decrease the concentration of antinutritional factors in pluses which much impact their nutritive values. The number of antinutritional factors in legumes is manifest to decrease at varying degress based upon the processing and food preparation technique involved in it. These detersion procedures are sometimes, time consuming, expensive and result in loss of nutrient and energy content or have user suitability matter. Accordingly, breeding programs at numerous international and national research centres are working to decrease the content of antinutritional factors to a secure extent leading to an enlarged proportion of grain legumes in meal in human and animals (Matric et al., 2005). Main objective of the review is to research about the local processing techniques used to reduce those and the antinutritional factors exist in various legumes.

MECHANISMS OF ANTINUTRIENT FACTORS

In general, only two mechanisms are there which act as toxicants in human body, 1. If chemical are presents in plant sources, it will decreases the utilization and absorption of one or the other nutrient (Awan and Anjum, 2010). 2. Most cases some naturally developing chemical compound presents in food which affects the bioavailability of the nutrients in food. These compounds include dietary fiber, plant phenolics, oxalates and phytates.

RAFFINOSE FAMILY OLIGOSACCHARIDES (RFOS)

In recent studies it finds that very good amount of RFO's are present in pigeon pea, black gram and chick pea. It human takes huge amount of pulses containing RFO's will effect in a negative way such as bloating, stomach discomfort, flatulence, cramps and diarrhea (Reddy et al., 1984; Guzman-Maldonado et al., 2010). Although RFO's also act as a positive way such as dietary fiber (Chibbar et al., 2010). The negative effects are mostly due to the truancy of α-galactosidase enzyme in small intestine that is necessary for the hydrolysis of α-1, 6 linkages exist in RFO's. The negative impact depends on the α-galactosidase and consumption pattern sensitivity of the consumer.

NEUROTOXIN

Higher consumption of grass pea (L. cicera, Lathyrus sativus L, L. ochrus and L. clymenum) which contains high concentrations of BOAA (β-N-oxalyl-amino-L-alanine) causes neurolathyrism, it indicates paralysis and disorder in animals and humans. More investigations are required in this field to understand the mechanism and pathway related to ODAP in grass pea.

PROTEINACEOUS COMPOUNDS

Proteinaceous compounds like trypsin inhibitors and haemagglutinins are found in soybean, mungbean, chickpea, cowpea, lentil and kidney bean etc. These items down the absorption of protein in human body and lead to poor food utilization which impacts growth of individuals. In soybean trypsin inhibitors is present which leads to reduce digestibility (Ndubuaku et al., 1989; Radha et al., 1989).

Higher consumption of Fava beans leads to favism. The sickness such as haemolytic anaemia, jaundice, haemoglobinuria high fever will begin after few hours of consumption. This may lead to death in children and in adults it takes 1 to 2 days to recover. This disease effects our metabolism system. Profease inhibitors belong from two different families such as Brown-Birk and Kunitz based on cystine contents and molecular weight. Whole soybeans contain 17-27 mg of trypsin inhibitor per gram of seed (Belitz and Weder, 1990; Liener, 1994).

LECTINS

Wide ranges of uses are there for pulse lectins, which are used for clinical and immunological studies. In pulses, lectin contains 0.6% in garden pea, 0.8% in lima and soybean and 2.4 to 5% in kidney bean in respect of total protein content. Consumption in higher amount of lectins results in nutritional deficiencies and immune reactions. Most probable effects of lectins are due to gastrointestinal distress through interaction of the lectins in the gut epithelial cells (Oliveria et al., 1989).

GOITROGENIC FACTOR

In 1993, the gotterogenic effect of soybean were discovered by McCarrison and further confirmed by other researchers in both chickens and rats. And some researchers also discovered the effect of soy milk on goiter, which can be increase by taking higher iodine contain.

AMYLASE INHIBITORS

Amylase Inhibitors are found in pigeon pea. Reduced dilapidated of the digestive enzyme is showed within a pH range of 4.5-9.5 and heat labile these inhibitors have been established to be active. This inhibitors form difficult with amylase which relies on temperature, ionic strength, pH, time and concentration of the inhibitors. These difficult inhibit bovine pancreatic amylase but fail to inhibit bacterial and fungal amylase. During late seed development this enzyme is synthesized and degraded during late germination in squab pea (Giri and Kachole, 1998). Among this pulse, chickpea and filed bean contain extremely low concentration of amylase inhibitors. Lentil, pea, lima bean, winged bean, soybean and adzuki bean showed no amylase activity (Grant et al.,

1995). This enzyme plays a important character in the breakdown of starch to issue spirit in the form of maltose and glucose. Existence of this inhibitors leads to decreased hydrolysis of polysaccharides i.e. glycogen and starch. As a result of reduced hydrolysis of polysaccharides a reduction in development was observed in chicken. Human use of these inhibitors as starch blockers reported to cause symptom

PHYTIC ACID

This acid is highly present in seeds, also present in tubers, roots and spores of many plant species. Grain crops basically have 10 mg phytic acid in 1 gm seed dry weight which denotes 65% to 85% of seed total P (Raboy 1990). In case of legumes phytic acid is present in soybean, chick pea, lentil and pea. In 1 gm seed, which produced by garin crops consist 3.0 to 4.0 mg P concentration, but with phytic acid it becomes 2.0 to 3.0 mg in 1 gm. In case of day pea, only 1% of phytic acid is present in embryo axis and 99% is present in cotyledons. Noneover, only 10% of total phosphorus in embryo axis and another 65% of total phosphorus in pea cotyledons comes from phytic acid phosphorus (Ferguson and Bollard 1976). Mainly in pea cotyledon 88% of phytic acid present but in case of seed coats no phytic acid is present. In case of pea, phytic acid raised from 0.16 to 1.23% during maturation (Welch et al; 1974) and in soybean phytic acid content increased from 0.87 to 1.26% during maturation (Yao et al; 1983). But in case of winged beans phytic acid content increased in proportional way at 4 development stages of seed maturity (Kadam et al; 1982). This is a strong chelator of mineral cations like iron, calcium and zinc forming mixed salts which are heavily excreted by non-ruminant animals like swine, fish and poultry and by human also (Sharply et al; 1994). Inositol and phosphorous in phytate are not available to non-ruminant animals, because those animals lack the enzyme phytase to remove the phosphate. Rumens have very high quantity of microorganism which helps to digest phytates. In case of livestock, if they consume low quantity of minerals, they ended up with weight loss. Bioavailability of minerals can be increased by reduction of phytate or phytase enzyme supplementation.

HEALTH BENEFITS

As we already discussed, legumes have high amount of various antinutritional factors, this it have negative effect on animal and human nutrition, although it plays a vital role in maintaining human health. To improve digestive system Garbanzo beans can be used, because Bacteria present in our colon can break the garbanzos insoluble fiber to fatty acids (SCFAs). The excess energy which released from SCFAs can reduce the incidence of cancer and increases the colon health (Chibbar et al., 2010). In study it has found that several body system are prone to oxidative stress and this damage by reactive O2 molecules. Legumes have substantial amount of antioxidants same as in chickpea, which play a pivotal role for supporting our body system. Due to high amount of antioxidants present in the legumes, it reduced risk of heart diseases if anyone consumes it regularly. Moreover it support to blood and blood vessels. It contains high amount of polyunsaturated fatty acids (PUFAs), including α-linolenic acid and omga-3 fatty acid. It anybody regularly consumer chickpea and other legumes it reduced coronary heart disease (Hu, 2003). It contains good source of minerals, vitamins and strong antioxidant composition, which might improve insulin function and blood sugar level (Jacobs and Gallahar, 2004).

ROLE IN PLANT GROWTH AND DEVELOPMENT

Antinutritional factors mainly accumulate in leaves, tubers, stems and seeds of plant (Avigad and Dey, 1997) and these factors play a pivotal role in seed germination, desiccation tolerance and preservation of seed longevity. During seed germination stoned carbon will released which reserves in seed. These reserves we can mostly find in the form of sugar, oil, polysaccharides, proteins etc. Furthermore, stored RFOs can play a pivotal role in the germination process, which sufficient energy is required to break down the all stored reserves (Blochl et al., 2007). But recent studies of Dierking and Bilyeu (2009) showed that for seed germination utilization of RFOs are not mandatory. The character of dessication tolerance in the legumes might be the result of antinutritional factors which protects membrane-bound proteins (Jones et al., 1999). Due to the viscosity of oligosaccharides present in seeds, it protects the membranes. Due to abiotic stress in legumes, it produces very high volume of concentration of

reactive oxygen species. Different generation of Reactive Oxygen Species (ROS) like hydrogen peroxide (H2O2), hydroxyl radical (-OH), superoxide radical (O2-) beyond antioxidant capacity of any biological system done oxidative stress (Aruoma et al., 1997; Shigeoka et al., 2002). Basically Antinutritional factors behave as antioxidants by protecting plant and scavenging hydroxyl radical from oxidative damage (Nishizawa et al., 2008).

TO REDUCES THE ANTINUTRITIONAL FACTORS IN LEGUMES VARIOUS LOCAL METHODS ARE USED

BY removal or reduction of undesirable nutritional factors we can improve nutritional status of legumes and can utilize their full potential as human and animal food. Several procedure to reduce the antinutritional factors are, use of enzymes to come down the antinutritional concentration and breeding of varieties low in antinutitional factors (Reynolds, 1974) and costly the simple local methods such as germinate seeds before cooking and soaking (Iyer, et al., 1980; Jood, et al., 1985). On local methods and antinutritional factors to reduce them and talk about breeding processing methods and approaches such as enzyme treatment is far away the scope of this review, this review is focussing. The antinutritional factors are discussed below to reduce local methods.

SOKING

By overnight night soaking of pulses we can reduce sizable amount of α-galactoside compression (Okolie and Ugochukwu, 1974). If we soak cowpea flour for around 16 hour it results in reduction of 28% and 26% of raffinose and stachyose compression respectively. Furthermore by soaking of chickpea for overninght we can reduce the compression of α-galactosides by atleast 16-27% (Frias et al., 2000). By using different parameter such as soaking time, seed water ratio, temperature, addition of sodium bicarbonate we can enhance the efficiency and effectiveness of soaking process (Jood et al., 1985; Vijayakumari et al., 1996; Abdel-Gawad, 1993; Ibrahim et al., 2002).

GERMINATION

Germination process is mainly used to reduce that α-galatosides compression in pulse. In this process complex sugars convert into simple sugar. By examine it proves that three days after germination process of lentils substantially reduces RFO's compression by at least 18-40% (Frias et al., 1996) and after four days of germination in pigeon pea it reduces 80% present of α-galacosides like earlier are noticed for may non-conventional legumes like doliches (Lablab purpureus), jack bean (Canavalia ensiformis), mucuna (Stizolobium niveum) and cowpea (Vigna unguiculata) (Martin-Cabrejas et al., 2008). Phytate is degraded by native phytatse throughout germination process.

COOKING

By using cooking we can abolish or decrease antinutritional factors in legumes. By using cooking process for around 60 minute we can reduce or mean decrease of 46.3% & 49.6% of RFO's in green gram and horse gram respectively. In case of soybean around 20.7% removal of stachyose and 52.3% removal of raffinose noticed during cooking (Mulimani et al., 1997). To reduce the BOAA content in khaseri dhal steeping process should be followed by boiling process. Furthermore limewater and autoclaving treatment of seeds at 15lb mm-2 for 10 minute will destroy the trypsin inhibitors. But Rao and Belavady (1978) explained and showed an increase in the quantity of oligosaccharides when cooking of pulse is done (1988).

CONCLUSION

The main objective of any crop improvement program is to better or increase the yield. By the plant breeding almost for every crop the quantum jump of yield has been achieved. But now a day everyone shifts from yield factor to quality of foods, which is the need of the hour. Now a day's general citizens are very conscious about their health and life style and most of them prefer good quality of food products. Several reduced antinutritional factors were development over a time in khsari dhal (Pusa-24 by IARI in India, Qulia-blanco in Chile, Line 8612 in Bangladesh) and brassica (single, double and triple zero varieties). Thus it become the responsibility of plant breeding to look into the needs of general public and focus on crop improvement activities by reducing the antinutritional factors.

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