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Review Article

Phytosterols of *Brassica Juncea* (Indian Mustard)

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ABSTRACT

Phytosterols are present in the all plant oils. Nutritionally it is the most important constituent of all the plant oils. It plays a very important role in different metabolic processes. Phytosterol content makes the edible oils healthy by increasing the cholesterol solubilization and decrease the risk of heart diseases. Mustard oil is the main edible oil in India. So, there is a requirement for enhancement of phytosterol content by external or inducing genes responsible for phytosterol. Different varieties of mustard have different composition of phytosterol and external factors also influence the composition of phytosterol in Indian mustard.

Key wards: phytosterol, cholesterol and metabolic

INTRODUCTION

Phytosterol belongs to the isoprenoid group. It is widely available nutraceutical compound obtained from plant oils, legumes, nuts and seeds. In cereal grains, fruits and vegetables, it is also reported but in modest quantity. In plant cells, they play a major role in membrane linked processes like regulation of membrane permeability, fluidity, various metabolic processes, membrane bound enzymes for signal transduction activities (Piironen et al., 2000) and also act as precursors of compounds which are involved in growth of plants (Hartmann MA, 1998). Phytosterols are structurally very similar to cholesterol but functionally opposite and nutritionally it is one of the most important constituent of oil, which is beneficial for human health. Some published articles shows that phytosterols consumed in normal habitual dietary quantities can affect cholesterol metabolism. In human beings, phytosterols increases the solubilization of cholesterol and as a result cholesterol absorption lowers in intestine. Till now no work has been done on phytosterol variation in Brassica juncea (Indian mustard) and environmental effects on the phytosterol contents in oil.

Indian mustard (Brassica juncea L.) Czern. is a largely cultivated oilseed crop in subtropical and tropical countries of Asia and Europe. Indian mustard is being developed as an oilseed for the low rainfall cropping zone. Some evidence suggested that Brassica juncea has comparatively better heat and moisture stress tolerance than canola, and so is predictable to perform more dependably than canola in poor rainfall areas. Undoubtedly, there is a need for more work for the improvement of nutritionally important oil contents of *Brassica juncea*.

Genes discovery for low erucic acid oil production in the seeds of Indian mustard help in the conversion of this crop to a canola-type oilseed for dry areas (Oram et.al 2005). Recently, scientists paying attention on minor oil and protein constituents like sterols (Hamama et al. 2003), tocopherols (Marwede et al. 2005) carotenoids (Shewmaker et al. 1999) and sinapate esters (Zum Felde et al. 2006). Altering the content and composition of

these minor constituents could give a major benefit to Indian mustard oil. In humans, Sterols are precursor of steroid hormones and bile acids and in plants produce brassinosteroids - phytohormones. (Lindsey et al., 2003), they play an important role in growth and developmental processes in living organisms (Hartmann, 1998). Plants have more than 40 well-recognized and studied sterols (Law, 2000) which are termed phytosterols and are largely present in oilseed plants. Plant sterols occur naturally in the diet primarily as minor components of vegetable oils while stanols, are hydrogenation compounds of the plant sterols and occur at a lower level.

Importance of Phytosterols

Phytosterols plays a leading role in numerous areas, specifically in pharmaceuticals for making therapeutic steroids, nutrition (e.g. anticholesterol additives in functional foods, anti-cancer properties), and cosmetics such as creams and lipsticks (Fernandes and Cabral, 2007). Phytosterol content has been documented as a cholesterol-lowering drug. The mode of action of Phytosterols is based on the capacity of plant sterol esters to decrease the intestinal absorption of externally taken and biliary cholesterol. Numerous research studies on the ability of phytosterol cholesterol lowering effect shows the possibility of using phytosterols as main ingredients in functional foods. The main conclusion is that the effective doses in between 1.5 - 3g/day, leading to reductions in LDL-cholesterol between 8% -15%. The chief mechanism of action is founded on interference with the solubilization of the cholesterol in the intestinal micelles and, thus, absorption is reduced. It is investigated that, ingesting phytosterols in a single dose per day or between meals are correspondingly effective methods for cholesterol lowering. Substantial and emerging evidence supports the inhibitory actions of phytosterols on liver, lung, stomach, colon as well as breast cancer by altering the physical properties of cell membranes. Hence, phytosterols could be combined in diet not only to lower the cardiovascular disease risk, however also to potentially kill cancer cells such as thyroid, prostate, bladder, liver, lung, stomach and pancreatic cancers and in cruel breast cancers. Efforts are made by researchers to find out its anti-cancer and anti-oxidative activities. In addition to these, plant sterols also have anti-inflammatory and anti-atherogenicity activity. Phytosterols can act through multistep mechanisms of action, comprising inhibition of carcinogen production, growing cancer-cell, angiogenesis, invasion and metastasis, and through the promotion of apoptosis of cancerous cells. The intake of phytosterol may also raise the activity of antioxidant enzymes and thus reduce oxidative stress. (Woyengo, 2009).

Genetical studies of phytosterols of *Brassica Juncea*

The important components of phytosterols in rapeseed are sitosterol, campesterol, brassicasterol and avenasterol with trace amount of stigmasterol and cholesterol. (Appelqvist *et al*. 1981). Quantitative trait loci (QTL) for different seed quality traits like oil content, composition of fatty acid, glucosinolates and tocopherols have been recognized earlier on molecular linkage maps of the rapeseed genome (Ecke et al., 1995; Uzunova et al.,1995; Marwede et al., 2005; Zhao et al. 2005, Qiu et al., 2006; Zhao et al., 2007). Fundamental work regarding the genetics and regulation of phytosterol biosynthesis and the different steps involved in the biosynthesis has been done in Arabidopsis (Schaller et. al.2004, Suzuki and Muranaka 2007, Nieto et.al. 2009). Many genes of phytosterol biosynthetic pathways have been cloned from Arabidopsis and some other plant species (Suzuki and Muranaka 2007). In Arabidopsis, biosynthesis of phytosterol happens through cytoplasmic mevalonate pathway (MVA). Biosynthetic step in MVA pathway is catalyzed by 3-hydroxy-3-methylglutayl-CoA reductase (HMGR) and cycloartenol C-24-methyltransferase

(SMT1) enzymes. These enzymes activity has been found rate limiting for the synthesis of phytosterols (Schaller et al. 1995, Manzano etal.2004, Suzuki et al.2009). Fundamental work regarding the different steps, the genetics and regulation of phytosterol biosynthesis has been done in Arabidopsis (Schaller et al., 2004)

There are few or limited evidence are available for genetic variation or environmental effects on phytosterol content in oilseed rape (Hamama et al. 2003, Abidi et al. 1999, Gordon and Miller 1997, Appelqvist et al. 1981), however possible connections between phytosterols and other seed quality traits, or genetic inheritance of phytosterol content have not at all been investigated. The possible reasons behind this could be that a somewhat sophisticated extraction and derivatization method is needed for identification of phytosterol and that so far there is no gas-chromatographic analysis for their exact quantification suitable for plant breeding purposes. Hence more research is needed in determining and improving phytosterol content in Indian mustard.

Future advancement for increasing *Brassica Juncea* phytosterol content

Ectopic induction expression of HMGR gene in Brassica juncea may led to 10 fold increase in the phytosterol level in seeds which will make the Indian mustard nutritionally good. In recent years increased interest in phytosterols lies in their potential to reduce plasma low-density lipoprotein cholesterol level, decreasing coronary mortality and therefore acting as naturally preventive dietary product. Phytosterols composition must be a major breeding aim for a high quality vegetable oil production.

Promising future lines for phytosterol content enhancement:

- Alternate external sources should be discovered for increasing content of phytosterol in Indian mustard.
- Industrial processes should be changed for extraction which minimizes the loss of phytosterol content in mustard oil.
- Different types of phytosterols must be separated from other sources and enrich the mustard oil with phytosterol.
- The genes required for phytosterol synthesis induction.

CONCLUSION

Phytosterols is the most important ingredients of edible oils and it makes the oil nutritionally healthy. Indian mustard oil quality can be enhanced by increasing the content of phytosterols by some external sources like change in environmental conditions and by proper enrichment technology. Proper analytical techniques like gas chromatography can identify the content of phytosterol and genetic modification could enhance the phytosterol content in mustard oil. Phytosterol content can make the edible oil healthy and reduce the risk of deadly diseases like heart attacks, cancer etc. As we know in India main edible oil is mustard oil so there is an enough research is required to make the mustard oil healthy.

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