# EFFECT OF PROCESSING METHODS ON THE QUALITY OF CEREAL AND LEGUME PRODUCTS

*By*

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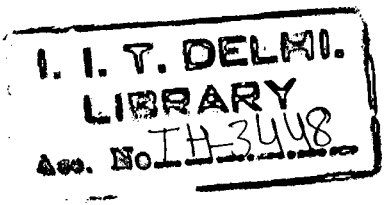
① Food processing ② Legume products






## CERTIFICATE

This is to certify that the thesis entitled, "**Effect of processing methods on the quality of cereal and legume products**" being submitted by **Ms. Jagriti Sharma** to the Indian Institute of Technology, Delhi for the award of the degree of Doctor of Philosophy is a record of bonafide research work carried out by her. Jagriti Sharma worked under our guidance and supervision, and has fulfilled the requirements for the submission of thesis, which to our knowledge has reached the requisite standard. The results contained in this dissertation have not been submitted in part or full to any other university or institute for the award of degree or diploma.

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5/8/06

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*To*

*My Parents*

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*Aum bhoor bhuwah swaha*

*Tat savitur varenyam*

*Bhargo devasya dheemahi*

*Dhiyo yo naha prachodayat*

*(May the Almighty god illuminate our intellect to lead us along the righteous path.)*

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## *ABSTRACT*

*Good quality food, apart from fulfilling basic need, is the key to sound physical and mental health; thus aiding in the holistic development of a human being. However, ensuring food quality and safety is a multidimensional complex phenomenon requiring holistic vision for pragmatic solution. Presence of toxic residues in food and inherent antinutrient factors in legume seeds are the major deterrent in providing quality food to humans. Cereals and legumes are the staple diet of rural populace and supply necessary nutrients for their health. However, chemical contaminants in food coupled with presence of antinutrients limit the bioavailability of these nutrients. In the backdrop of some known reports on these aspects, it was of interest to investigate and identify the suitable processing methods that help obtaining food products with enhanced nutrients and minimum load of toxicants.*

*Keeping the above in view, present study was undertaken to explore the potential of various simple food processing methods to improve the quality of cereal and legume products, with following major objectives:*

- *To study the effect of different processing methods on bioavailability of nutrients and reduction of antinutritional components for enhancing the quality of legume based food*
- *To study the effect of processing of cereals on dissipation of pesticides and mycotoxins for food safety.*

*The thesis entitled, "Effect of processing on the quality of cereal and legume products" (organized in 4 chapters) starts with a brief introduction on the theme, presents literature review on relevant aspects and focuses attention on two important aspects, viz., bioavailability of nutrients and antinutrients and dissipation of chemical pesticides and mycotoxins in food.*

*Experimental work on four legumes namely, Moong beans (Phaseolus aureus), Cowpea (Vigna unguiculata), Chickpea (Phaseolus mungo) and Lèntils (Lens culinaris) reveals very interesting results. The nutrient content in processed food was found to vary with legume genus. The bioavailability of all the nutrients studied (mineral, vitamins, starch, sugar, proteins, fiber) on processing of legumes showed an increasing trend. Out of all the processing methods selected, viz., atmospheric cooking (AC), pressure cooking (PC), roasting (Ro) and sprouting (Sp), sprouting was found superior method of processing in terms of increased bioavailability of minerals, vitamins (particularly riboflavin), fiber and proteins. For example ~ 500% increase in iron content has been noted in case of chickpea. Roasting also showed comparable effect in this context. Surprisingly, atmospheric cooking, a traditional method was found to increase the availability of soluble sugars with decreased galactose content and increased resistant starch (RS) as compared to pressure cooking. Decrease in galactose is beneficial since it is the building block of some sugars like raffinose, stachyose and verbascose which are implicated in flatulence, while increase in RS helps in the slow availability of sugars in body and may prove a good source to decrease blood sugar levels in diabetic patients. Interestingly, these processing methods were also found*

*effective in reducing the antinutritional content (tannins, phytic acid, trypsin inhibitor activity) of legume seeds making them palatable and digestible thereby, reducing flatulence and other harmful effects of antinutritional factors. Sprouting was found best in reducing phytic acid and trypsin inhibitor activity. Positive correlation was observed between reduction of antinutritional components and bioavailability of minerals. The phytate/zinc molar ratio (2.8) was also found well below 15 indicating better zinc bioavailability after processing of legume seeds.*

*Bread making, in view of its consumption world over, was chosen as the representative process to study the dissipation of pesticides and mycotoxins. This process was found to considerably reduce pesticide and mycotoxin residues. However, the reduction depended on the nature of chemical pesticide, with maximum loss observed in endosulfan content (70%) followed by deltamethrin (63%), malathion (60%), propiaconazole (52%), chlorpyriphos (51%) and hexaconazole (46%). Mycotoxins dissipation (DON; 45.92% – 86.45% and NIV; not detected – 48.56%) was also observed during bread making process. However, the loss of these toxins was lowest in the wholewheat bread as compared to wheat bread, mixed bread and rye bread. Surprisingly, substituting rye (Secale cereale) with whole wheat (Triticum aestivum) had a favorable distinct effect on the dissipation of mycotoxin content in the bread.*

*In toto, the research findings reveal a strong possibility of providing safe and nutritious food from available cereals and legumes using simple traditional processing techniques. Infact this study provides an insight into the complex issue of food quality and safety. Considering the special role of galactose, resistant starch in the treatment and prevention of very common health problems related to flatulence and blood sugar, significance of these research findings would increase manifold due to simplicity and effectiveness of the proposed food processing methods. In view of contamination of food resulting in numerous health problems, dissipation of chemical pesticides and mycotoxins through processing techniques would prove a boon during the transient phase of agriculture system moving towards sustainable agriculture.*

*Overall, present study shows us an optimistic path to handle the complex issue of food security and safety. However, the challenge lies in infusing these concepts in the modern life style, currently emerging even in the rural sector.*