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Processing Technologies for Improved Utilization of Pulses

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Introduction:

Ensuring food security has emerged as a significant challenge in the 21st century, especially with the rapid growth of the global population. Since ancient times, cereals and grain legumes have played a crucial role in providing a balanced diet across various regions of the world. In India, a developing country where malnutrition and poverty remain persistent issues, cereals and pulses form the dietary foundation, particularly for the predominantly vegetarian population. According to the Indian Council of Medical Research (ICMR), an intake of 80 grams of pulses per day is recommended for an active adult male. For vegetarians, maintaining a sustainable and nutritious diet heavily relies on protein-rich grain legumes. These pulses not only serve as a major source of dietary protein for humans but are also important as animal feed. Health guidelines also suggest the daily intake of at least three servings of fruits or vegetables, ensuring dietary diversity by including plants from various botanical families. Pulses refer to the edible dry seeds of leguminous plants, including commonly consumed varieties such as beans, chickpeas, lentils, peas, and cowpeas. These seeds come from plants belonging to the Fabaceae family (formerly known as Leguminosae), which is one of the largest families of flowering plants, comprising around 700 genera and approximately 18,000 species. Legumes can range from herbaceous plants to woody structures, with their seeds typically being hard-shelled and either kidney-shaped or rounded. When used as dry seeds for food, legumes are referred to as pulses or grain legumes. Although the terms pulses and

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legumes are often used interchangeably, the Codex Alimentarius Commission of the FAO/WHO distinguishes between the two based on fat content. According to this classification, pulses are specifically dry, edible seeds of leguminous plants with low fat content, while legumes as a broader category also include oil-rich seeds like soybean and peanut.

Pulses serve as a vital food source for over 2 billion people worldwide, with approximately 69 million tons of beans, lentils, and chickpeas cultivated across 78 million hectares globally. India contributes around 1.5% to global pulse production, ranking third in chickpea production and fourth in lentil production. The nutritional significance of pulses can play a transformative role in addressing global malnutrition. Recognizing their importance, the Food and Agriculture Organization (FAO) and the United Nations declared 2016 as the "International Year of Pulses," highlighting them as "nutritious seeds for a sustainable future." Similarly, the Indian Pulse and Grain Association has promoted pulses as key to achieving both nutritional well-being and food security, given their rich composition of plant-based protein, energy, dietary fiber, essential micronutrients, and bioactive compounds. Pulses typically contain 18–32% protein, offering a valuable source of essential amino acids and bioactive peptides, making them particularly beneficial for low-income populations striving for food self-sufficiency, especially in rural India. Unfortunately, many in these communities still face challenges in meeting their protein requirements. Pulse proteins also exhibit beneficial functional properties such as water-holding capacity, fat binding, foaming, and gel formation, making them suitable for developing a wide range of food products. Beyond nutrition, pulses provide several health benefits, including potential roles in reducing the risks of cancer, diabetes, and heart disease. Despite India's significant pulse production, the country still relies on imports to meet domestic demand. This dependency is not solely due to production limitations but also because of substantial post-harvest losses, which account for an estimated 25–30% of total pulse production. Such losses reduce the availability of high-quality pulse products, leading to increased imports and negatively impacting the earnings of local farmers across various states. Reducing these post-harvest losses, particularly in protein-rich legumes, is essential for achieving true nutritional security in India and other developing countries. However, a major challenge remains the lack of awareness and technical knowledge among field workers, extension agents, farmers, and rural entrepreneurs regarding proper post-harvest management, processing, and value addition of pulses. Addressing these gaps and improving post-harvest practices is therefore a critical step toward ensuring food and nutritional security.

Importance of Post Harvest Technology and Processing in Pulses

Preventing post-harvest losses and enhancing the value of raw food commodities through preservation and processing are two key goals of post-harvest technology. The process typically begins with cleaning, sorting, and grading of raw food materials, followed by conditioning for either storage or further processing. The significance of post-harvest technology lies in its capacity to help meet the food demands of a growing population by minimizing losses and creating more nutritious food products through efficient processing and value addition. In India, about 70% of pulses undergo processing, making post-harvest technology a critical factor in improving per capita availability. Value addition in pulses has gained importance in India due to increasing socio-economic diversity, industrial development, and urbanization. This approach not only offers better returns for producers and processors but also enhances the taste and nutritional quality of food products. Milling, one of the oldest forms of food processing, involves reducing materials from larger to smaller sizes. Milling tools like quern stones date back to the Neolithic period (around 5600 BC) and were historically used to produce flour or split pulses (dhal). The term 'dhal' comes from the Sanskrit word 'dal,' meaning "to split," with references to pulses such as chickpea and pigeon pea appearing as early as 700 BC in ancient Indian texts by Charaka and later by Susruta in 400 BC. Pulses, particularly in the form of dhal or flour, have historically been viewed as a critical part of a nutritious diet. Based on historical evidence, pulse milling in India likely originated between 3,500 and 7,600 years ago. Today, about 80% of pulses consumed in India are in the form of dhal or flour, making milling one of the most significant post-harvest processes for pulses.

Traditional milling in India typically yields about 65–70% dhal, lower than the theoretical maximum yield of 80–90%, which is why scientific research in pulse milling is essential. Key processes in pulse milling include:

1. **Dehulling or decortication** – removing the seed coat to obtain polished seeds or "gota."
2. **Splitting** – separating the two cotyledons to produce splits or dhal; this often occurs simultaneously with dehulling.
3. **Grinding** – reducing whole seeds or cotyledons into flour.

Technologies to reduce post-harvest losses in pulses focus on optimizing harvest practices, minimizing losses during handling, storage, and transportation, and improving processing with modern machinery. Other preservation techniques include thermal processing, drying, chemical treatments, and advanced packaging methods to enhance shelf life and portability. By reducing post-harvest losses, a larger supply of high-quality food becomes available, benefiting both consumers and farmers with better returns. Post-harvest technology also offers potential for promoting rural industries. In India, where about 80% of the population resides in villages and 70% depend on agriculture, industrialization has often drawn food processing industries toward urban centers. This has led to capital outflows from rural to urban areas, reducing employment opportunities in villages and increasing economic disparities. By developing rural-based agro-industries, farmers can transition from being mere producers to becoming processors as well. This transformation not only increases their earnings but also fosters rural economic development, reduces migration to urban areas, and aligns agricultural communities with modern economic growth.

Pulses Processing Technologies

Before legumes can be used as a food ingredient or served as a prepared dish, they undergo a series of processing steps. Processing plays a crucial role in the marketing of pulses today, as it transforms the harvested crop into forms suitable for human consumption, often as value-added products. One of the primary processing methods is splitting whole seeds into dal, with more than 75% of the total legume production in India processed in this way. Pulse processing is predominantly a small-scale industry, with thousands of dal mills spread across the country, particularly concentrated in major production hubs like Indore (Madhya Pradesh), Jalgaon and Akola (Maharashtra), as well as metropolitan areas such as Mumbai, Kolkata, Chennai, Hyderabad, and Delhi. The typical steps involved in pulse processing include cleaning, drying, sorting, splitting, milling, and fractionating. Depending on the specific type of pulse and its intended use, additional steps like de-hulling, puffing, roasting, and grinding may also be applied. Upon arrival at processing facilities, field-dried pulse grains undergo visual color inspection and quality assessment by experts before being transferred to storage bins. Proper storage practices are critical for maintaining quality by preventing insect infestations and fungal growth. Maintaining optimal temperature and humidity levels ensures better preservation of the pulses, as different crops require specific storage conditions. After processing, the final product is packaged and transported to markets for sale. Pulses may be sold after basic cleaning, or undergo additional processing like de-hulling and splitting, which improves digestibility and enhances product quality for consumers.

To improve de-hulling and splitting efficiency, pulses are commonly soaked in cold water for 5 to 12 hours, with warm water often used to accelerate hydration and soften hard seeds. For pulses with particularly thick or tough seed coats, mechanical cracking before soaking helps promote moisture absorption. This practice not only reduces cooking time but also improves the digestibility of the cotyledons. While heating can further enhance hydration, it is a costlier process and requires careful control to maximize yields and prevent microbial contamination. In some parts of Asia, food legumes are left at ambient temperatures post-soaking for several days to encourage germination. This activates natural enzymes that partially break down proteins, starch, and oligosaccharides, making the grains more nutritious and digestible. These sprouted grains can be consumed as-is or further processed by de-hulling, roasting, or grinding. Pulses can be consumed either whole or as processed ingredients like flour. Producing flour involves grinding whole or split pulses into dry flour or wet batter for various culinary applications. Factors such as the composition of the pulse, fineness of the grind, ratio of particle sizes, and cooking conditions influence the texture, mouthfeel, and overall quality of the final food products.

Value addition to Pulses Products

With the growing need for foods that cook quickly, ensure microbial safety, and maintain high quality, value addition in pulses can play a transformative role in the food market. Pulses serve as an affordable and excellent source of plant-based protein, far more economical than nuts, dairy products, meat, or fish. Their versatility extends to bakery products like pasta, bread, and snacks. In the realm of processed foods such as breads, pastas, snack foods, baby foods, and sports nutrition products pulses are increasingly becoming key ingredients. They also hold significant potential for enhancing breakfast cereals and ready-to-eat or partially prepared pulse-based meals, catering to the modern demand for convenient meal solutions.

At every stage of processing, value is added to the raw material. In India, it is estimated that about 75% of the total value addition occurs during primary processing, while 25% happens during secondary and tertiary stages. The dominance of primary processing highlights its crucial role in improving the economic well-being of farmers by increasing their earning potential. Historical records, including scriptures like the Puranas and epics like the Mahabharata, show that pulses have been integral to the Indian diet for centuries, commonly consumed in meals such as dal-chawal and dal-roti, and used in snacks like sattu and besan laddoos. Pulses have remained a staple across India's diverse culinary landscape. Sattu, often regarded as one of the earliest forms of instant food, has its origins dating back to the Rigveda (around 8000 BC), made from roasted chickpeas combined with barley or wheat flour, serving as a vital food for people living in difficult conditions. Papads, another beloved traditional snack, are typically made from black gram flour mixed with salt, oil, and spices. Modern innovations have introduced value-added variations by incorporating cereal flours, leafy greens, and other nutritious ingredients. Internationally popular pulse-based products like hummus, made from chickpeas, have gained recognition for their health benefits, notably reducing post-meal blood glucose spikes by four times compared to white bread. Recognizing this potential, the Indian Institute of Pulses Research (IIPR), Kanpur, has emphasized that pulses can be successfully marketed as "Health Food" or "Nutri-Rich Food." Industrialization has reshaped India's rural economy, presenting new opportunities for growth. By focusing on improving agricultural production, enhancing processing methods, adding value, and strengthening trade connections to urban markets, farmers can achieve better financial returns and elevate their socio-economic status. Given these possibilities, it is an opportune time to drive a value-added revolution in the pulse industry, benefiting producers and consumers alike.

Conclusion

In recent years, post-harvest technology in pulses has gained significant attention as a key driver for rural industrialization. During various stages of post-harvest handling, pulses suffer substantial quantitative and qualitative losses, making it essential to focus on minimizing these losses effectively. With industrialization, most processing activities have migrated to urban centers where infrastructure is better developed. However, there is an urgent need to reverse this trend by fostering income generation and employment opportunities in rural regions through processing and value addition.

These strategies offer a practical solution to empower rural communities while enhancing the pulse sector. Moreover, marketers have a crucial role to play by building strong, recognizable brands that inspire consumer loyalty, with brand image playing a central role in capturing and retaining market share. The declaration of 2016 as the "International Year of Pulses" by the United Nations provided an ideal platform to introduce policy-supported initiatives aimed at developing new products and strengthening pulse marketing. Beyond creating new market prospects, efforts should be made to adopt standardized grading and classification systems for different pulse varieties. This would help meet the diverse requirements of trade sectors and improve consistency in quality and pricing. A critical policy measure that needs consideration is integrating value-added pulse products into government nutrition programs. This could involve directives and awareness campaigns highlighting the health benefits of incorporating protein- and micronutrient-rich pulse-based foods into national nutrition schemes, such as those targeting children, adolescent girls, pregnant women, and school mid-day meal programs. Ultimately, the responsibility rests with marketers to implement impactful campaigns, offer high-quality products, and develop pricing strategies that align with consumer expectations. Tailoring marketing approaches to suit the preferences of consumers in different city tiers will help foster consumer trust and long-term loyalty, thereby expanding the market for value-added pulse products.

References

1. Hatice P. (2017). Pulse Processing Technology, International Conference on Technology, Engineering and Science (ICONTES), 1: 336 – 338.

2. Hefnawy, T. H. (2011). Effect of processing methods on nutritional composition and anti-nutritional factors in lentils (Lens culinaris). Annals of Agricultural Science, 56(2): 57–61.

3. Hu, F. B. (2003). Plant based foods and prevention of cardiovascular disease: An overview. American Journal of Clinical Nutrition, 78: 544-551.

4. Hudson, B. J. F. and El-Difrawi, E. A. (1979). The Sapogenins of the seeds of four lupin species. Journal of Plant Foods, 3:181–186.

5. Indian Council of Medical Research (2010). Nutrient Requirement and Recommended Dietary Allowances for Indians-A Report of the Expert Group of the Indian council of Medical Research. National Institute of Nutrition, Hyderabad.

6. Jain, A. K., Kumar, S. and Panwar, J. D. S. (2009). Antinutritional Factors and Their Detoxification in Pulses - A Review. Agricultural Review, 30(1): 64 – 70.

7. Jambunathan, R. and Singh, U. (1989). Present status and prospects for utilization of chickpea. In Proceedings of Second International Workshop on Chickpea Improvement. ICRISAT, Hyderabad, India, pp. 41-46.