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Processing, Standardization and Value Addition to Kidney Bean (*Phaseolus Vulgaris L.*) Flour

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Kidney beans (*Phaseolus vulgaris L.*) are annual plants in the Fabaceae family. They're an immense source of plant-based protein, fiber (both soluble and insoluble), starch, and vitamins. Legumes, like kidney beans, are key protein sources for both people and animals. Kidney beans are packed with nutrients: about 3.5% minerals, 5.1% crude fiber, 22.7% protein, 57.7% carbohydrates, and only 1% fat. They're low in saturated fats and sodium but high in healthy unsaturated fats.

Kidney beans are grown and eaten all over the globe, offering a great source of protein, carbohydrates, and fiber, as well as vitamins and minerals. However, their popularity is sometimes affected by toxins like tannins and other anti-nutritional factors. Soaking the beans before cooking softens them, speeds up cooking, reduces these toxins, and improves their quality. To make kidney beans safe to eat and to eliminate harmful substances, boiling and cooking them thoroughly can be done. Kidney beans and their flour are used in many Savory dishes worldwide. Kidney bean flour can be incorporated into various products that are easy to transport, label, and sell. These products are designed to meet market demand and offer health, nutrition, and convenience benefits to consumers. Convenience foods, such as instant mixes with kidney bean flour, save cooking time.

Processing of Kidney bean flour

The kidney beans can be processed using various methods, such as 1. Drying and grinding the seeds using coffee grinder, pestle and mortar (Ramzy and Putra, 2021). 2. Sorting, cleaning, soaking drying and sieving (Abimbola *et al.,* 2020). 3. Sun drying and grinding (Mukta *et al.,* 2020). 4. Germinating, drying and grinding (Siban and Riar, 2020). The outline and flowchart (Fig 1) for processing and standardization of kidney bean is given below.

Standardization of kidney bean flour

1. **Cleaning:** The red and white varieties of kidney beans: Rajmash 1404 (Red), Rajmash 1644 (White) were cleaned thoroughly under running water.
2. **Boiling:** The cleaned kidney beans were boiled at 100^{0}C for 20 minutes until the bean became soft.
3. **Soaking:** The boiled beans were then soaked overnight in 1:4 ratio with water at room temperature.
4. **Drying:** Soaked beans were dehulled manually and dried at 60^{0}C in a hot air oven.
5. **Griding and sieving:** The dried seeds were ground and sieved to gain even and smooth flour.
6. **Packing and storing:** The obtained red and white kidney bean flours (RKBF and WKBF) were packed in food grade aluminium foil, clearly labelled and stored at room temperatures separately.

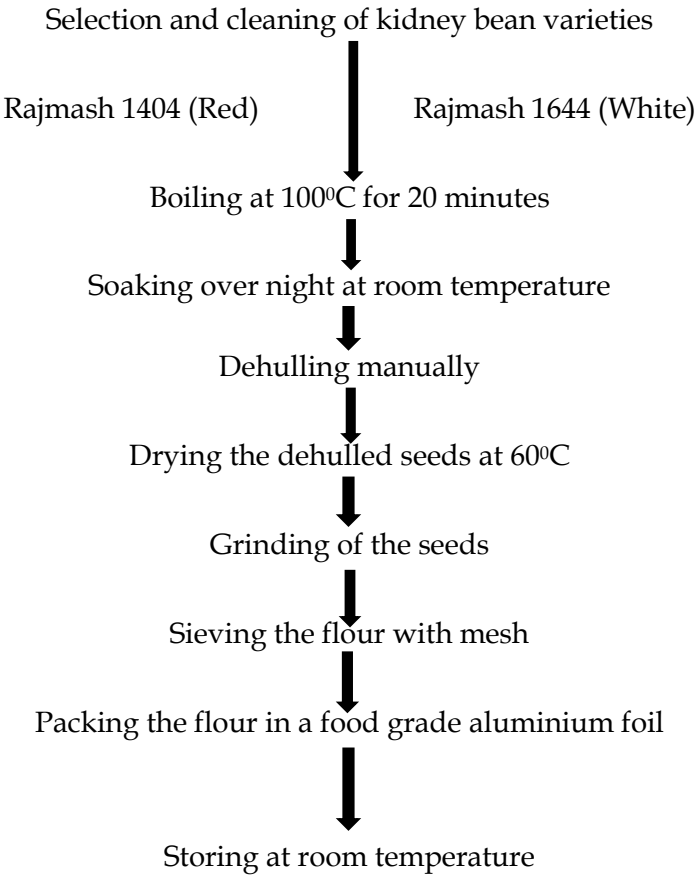

Fig. 1: Flow chart for preparation of flours

Physico chemical and Nutritional composition of Kidney bean flour

The physico-chemical properties of the developed flours such as bulk density and water

absorption capacity and functional characteristics like gel consistency were studied. The results showed that bulk density, Water Absorption Capacity and gel consistency of RKBF and WKBF were 0.94 g/cm^3 and 0.92 g/cm^3, 1.22 g/g and 1.19 g/g, 43.33 mm and 45.66 mm respectively.

The nutrient composition of 100 grams of RKBF and WKBF was determined. The moisture, protein, crude fat, crude fiber, calcium and iron contents of RKBF and WKBF were 11.2% and 11.4%, 25.64g and 24.3g, 1.79g and 1.65g, 4.05g and 2.77g, 256mg and 249mg, 4.8g and 4.9g/100g respectively.

Value Addition to Kidney bean flour

Value addition to food involves enhancing the appeal and utility of raw food products by processing them into more desirable forms. This can include turning fresh produce into canned goods, ready-to-eat meals, or snack foods. By adding value, the shelf life, convenience, and nutritional content of the food can be improved, making it more attractive to consumers. Additionally, value-added products often command higher prices, benefiting producers economically. This process also allows for the creation of functional markets and the reduction of food waste. Examples of value-added products include breakfast cereals, jams, ice creams, juices, yogurts, cheeses, pickles, concentrates, sauces, ketchup, and extruded snacks.

Culinary Uses

In the culinary world, kidney bean flour is a versatile gem. It shines in bakery goods cookies, biscuits, bread, muffins etc and brings a delightful value to traditional Indian dishes like idly, dosa, and dhokla (Fig 2). Its mild, nutty flavour and adaptable nature make it a perfect substitute for other pulses, adding a unique touch to a wide range of recipes.

- **Kidney bean flour:** Kidney bean flour, with its unique feature, the low glycaemic index 32.47 (Xu *et al.,* 2022) is an ideal food for people with diabetes. Its adaptability and versatility with good sensory and functional properties, makes it a better option for a variety of foods.
- **Nutritional Supplements:** The high nutrient content of kidney bean flour makes it a potential ingredient in nutritional supplements and protein powders.
- **Bakery products:** The bakery sector is one of the most rapidly expanding segments within the organized food industry in India. Recently, efforts have been made to create bakery products using non-wheat-based composite flours that offer high nutritional and sensory qualities (Chinma *et al.,* 2012). Research has shown that Kidney bean flour can be incorporated into a variety of bakery products such as cookies (Noah and Adedeji, 2021), biscuits (Mukta *et al.,* 2020) and bread (Ramzy and Putra, 2019) without compromising the sensory, functional and nutritional attributes. The incorporation of kidney bean flour up to a level of 40% in the gluten-free bread formula resulted in products with improved sensory and functional properties compared to the wheat bread (Stoin *et al.,* 2019).
- **Convenience foods:** In the processing industries, convenience foods enhance the storage level in the flours and ready-to-use products and increases the nutritive value of the products. They also enhance the income of processors and distributors. Storage of kidney bean flour and ready-to-use value added products in various packaging material like polythene bags and laminated aluminium packs increases the ease of handling and processing in the future. Mainly the marketing deals with innovative and ideal packaging and good storage techniques to increase shelf life of the product.

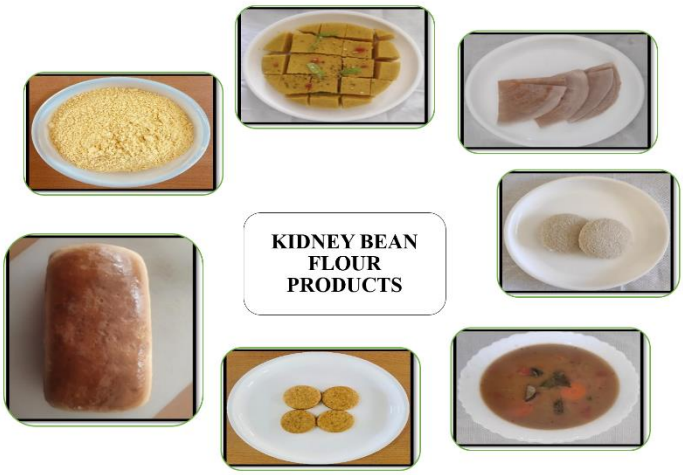

Fig 2: Kidney bean flour based products

Conclusion

In conclusion, kidney beans (*Phaseolus vulgaris L.*) offer immense nutritional benefits, serving as a key source of plant-based protein, fiber, and essential vitamins and minerals. Despite their inherent anti-nutritional factors, proper processing methods such as soaking, boiling, and drying can significantly reduce toxins and enhance their quality. Kidney bean flour, derived from these beans, is a versatile ingredient with a low glycemic index, making it suitable for a variety of culinary applications, including bakery products

and traditional dishes. The integration of kidney bean flour into food products not only boosts their nutritional value but also caters to the growing demand for convenience foods. Furthermore, value addition through innovative processing and packaging enhances the appeal, shelf life, and marketability of these products. Overall, kidney bean flour presents a promising avenue for creating nutritious, convenient, and economically viable food products.

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