CHAPTER VI
SUMMARY AND CONCLUSIONS

Food forms the diet and diet forms an important component of health and nutritional status of the individual, family and community. In maintaining good health, nutrition plays a vital role in the whole life span of human being. Lack of physical activity, faulty dietary habits and lifestyle, not only impair one’s health and nutritional status but also make one suffer from deficiency as well as chronic and degenerative diseases. Deficiency of macro as well as micro nutrients results in malnutrition. Malnutrition being a reflection of unfulfilled dietary demands and is a common feature of the vulnerable groups of society. The onset of these diseases is insidious, but once developed, they are difficult to get rid off. They not only affect the life expectancy but also significantly dent the quality of life.

Another fact that people have started taking stock like writing on the wall is that prevention of deficiency and degenerative diseases should become the preferred priority over the curative option. The Green revolution has not increased the productivity of pulses; instead its emphasis on cereals has often led to a decrease in legume production. Thus in the present perspective of our economic development, harnessing legumes optimally for nutrition, in combination with cereals to make it nutritionally balanced, appears to be the only plasnible approach to eliminate “protein-energy” malnutrition in the near future. In this context, kidney beans (Phaseolus vulgaris), a underutilized legume foodstuff, is one such important legume food whose potential remains to be tapped fully. A cheap crop, rich in protein, iron and calcium, it has the ability to cure a number of diseases. For instance, regular consumption of kidney bean varieties for a few months has also been said to offer protection against degenerative diseases like- cancer, diabetes, coronary heart disease on one hand and deficiency diseases, like- protein-energy malnutrition on the other.
Taking stock of the above mentioned facts, the present study, aimed at exploring the nutritional and product development application of kidney bean varieties, was planned with the following objectives-

- To undertake the nutritional assessment of native and processed forms of kidney bean varieties.
- To apply household adaptable processing strategy- hot water blanching, for optimizing nutrient yield and antinutrients removal from kidney bean varieties.
- To develop the food products by using the native and processed kidney bean varieties, by following life span development and health promotion approaches, taking leads from traditional wisdom and nutritional knowledge.
- To undertake the acceptability trials for different food products with the help of semi-trained panels.

The study was carried out in two phases, I and II. In the first phase, beginning was made by procuring the selected species of Phaseolus from Rajasthan Seed Corporation, Jaipur and Indian Institute of Pulse Research, Kanpur (U.P.). After procurement, kidney beans of the three varieties were thoroughly cleaned, freed from dirt and foreign matter and divided into two portions. A small portion of beans was ground to a fine powder or flour and rest of it was subjected to processing treatment. Hot-water blanching has been the processing treatment to which beans were subjected in water at 95°C for 30 minutes. Thereafter, blanched beans were soaked overnight in fresh water. Next morning, they were dehulled and dried in sunlight as per the laid down procedure. After drying, they were finely ground into the powdered form. Further, the two types of kidney bean flours of three varieties (raw and blanched) were subjected to nutritional analyses. Suitable portions of the flours were subjected to various types of analysis like proximate, minerals, antioxidant and antinutrients; in the food analysis laboratory of the Food Science and Nutrition department of the university. The first phase focused on analyzing nutrients, antinutrients, antioxidants of raw beans and their effect on hot-water blanching.
Results point out that blanching positively affects the nutrient profile of kidney bean varieties and hot-water blanching in its augmented incarnation incorporates steps such as overnight soaking and dehulling. Second phase involved food product development encompassing nineteen recipes for the different age groups; namely infants, preschoolers, schoolers, adolescents, adults, elderly, expectant women and lactating mothers. Further, food products have also been planned for deficiency diseases like protein-energy malnutrition and other debilitating diseases like diabetes mellitus and coronary heart disease. Six variants each of standard recipes were prepared by incorporating varying proportions of raw and processed (hot-water blanching) kidney bean varieties respectively. Sensory evaluation of food products was done by 15 semi-trained personnel (postgraduate students of Food Science and Nutrition) selected through the triangle test. Products were evaluated for individual sensory attributes with appearance, color, texture, taste, flavor, after taste and overall acceptability on 9-point hedonic scale. Therefore, second phase focused on the acceptability evaluation of different recipes incorporated with kidney bean varieties aimed at different age groups and various ailments.

Results of the study have gone to reveal that the variants of recipes were as well accepted as their respective standards in terms of all attributes. In all the recipes, standard was most acceptable followed by Variants- A1, B1 and C1.

In a nut shell, the study pointed out that processing of kidney bean varieties becomes the positive modulator of their nutritional profile as a part of various food products. To harness their nourishing potential, incorporation of raw and processed forms of kidney bean varieties could become beneficial in synergizing other healthy life style practices; such as moderate physical activity and prudent diet partaking based on low fat, protein, fiber and calcium rich food products. For individuals at risk or already suffering from deficiency and debilitating diseases, kidney bean based food products can aid in the prevention and management of these ailments. As it is becoming known that dietary intervention with vegetarian diet is a cheap, natural and safe approach for the prevention and management of lifestyle diseases of the present era.
The salient features of this study have been as under:

- In the context of proximate principles, hot-water blanching increased moisture and carbohydrate and decreased the ash, fat, fiber and protein content.
- As for minerals, hot-water blanching increased the calcium, iron and phosphorus content.
- In the context of antioxidant analysis, hot-water blanching decreased phenol content.
- Among antinutrients, hot-water blanching decreased the tannins, phytic acid, total cyanogens and trypsin inhibitor activity.
- In view of the above mentioned observations, hot-water blanching seemed more appropriate and suitable method for harnessing the nutritional worth of kidney bean varieties.
- Acceptability evaluation studies revealed that most of the test recipes were as acceptable as their respective standards when sensory evaluated for various attributes.
- Cookies-en-rajmah was the most acceptable recipe among all the developed products, followed by rustic papdi, bean-bade, raj-rasam and augmented-poppadoms.
- Chivra rajmah premix and wheat rajmah premix both were least acceptable test recipes than other developed recipes.
- After standard, Variants- A1, B1 and C1 of most of the recipes were most acceptable followed by Variants- A2, B2 and C2.

The study results explicitly point towards an improvement of processed forms of kidney bean varieties vis-a-vis the raw ones. Thus processing should become an essential pre-requisite in harnessing the nutritional profile of kidney bean varieties. The food product development using raw and processed forms of kidney bean varieties could provide respite to the masses by improving the health and nutritional status of normal and vulnerable people in different stages of life owing to nutrient-phytochemical combination in kidney bean varieties. Development of better characterized, research-proven products will help enhance consumer confidence in nutraceutical and functional food products amongst masses of developing nations.