4. Objectives

1. To determine the factors such as polyphenols and phytates that limit efficiency of iron fortification in chosen food vehicle and to study effect of novel processing technologies like heat treatment and irradiation for reduction of the same.

2. To optimize the process parameters and product formulation for various processing techniques in the development of fortified product.

3. To evaluate the bioavailability, retention and stability of fortificant and to establish shelf life of the product.

Plan of work

1. Standardization of methods to estimate inhibitors of iron absorption in roasted coffee beans.
   a. Standardization of method for polyphenol estimation from roasted coffee beans.
   b. Standardization of method for phytate estimation from roasted coffee beans by anion exchange chromatography.

2. Evaluation of the combined effect of roasting and irradiation on anti-nutrient levels and their iron binding ability in coffee beans.
   a. Combined effect of roasting degree (CCL-L, CCL-M, CCL-D) and gamma irradiation (4, 5 and 6 kGy) on polyphenol content and their iron binding ability in coffee beans.
   b. Combined effect of roasting degree (CCL-L, CCL-M, CCL-D) and gamma irradiation (4, 5 and 6 kGy) on phytate content in coffee beans.
   c. Combined effect of roasting degree (CCL-L, CCL-M, CCL-D) and gamma irradiation (4, 5 and 6 kGy) on total iron binding ability in coffee beans.
d. Combined effect of roasting and irradiation on physical attributes of coffee beans: texture and color.

e. Combined effect of roasting and irradiation on chemical attributes of coffee beans: oxidative changes (peroxide values) and fatty acid profile.

f. Combined effect of roasting and irradiation on sensory quality of prepared coffee.

3. Optimization of drying technology for the production of instant coffee powder mix.

a. Optimization of Spray Drying technology for instant coffee powder mix production.

b. Optimization of Freeze Drying technology for instant coffee powder mix production.

4. Evaluation and comparison of quality parameters of freeze dried and spray dried samples of instant coffee powder mix, skim milk powder and coffee extract.

a. Evaluation and comparison of physical properties of freeze dried and spray dried samples of instant coffee powder mix, skim milk powder and coffee extract.

b. Evaluation and comparison of thermal properties of freeze dried and spray dried samples of instant coffee powder mix, skim milk powder and coffee extract.

c. Evaluation and comparison of moisture sorption characteristics of freeze dried and spray dried samples of instant coffee powder mix, skim milk powder and coffee extract, at ambient (25 ± 2 °C) and accelerated (37 ± 2 °C) storage conditions.
d. Evaluation and comparison of micro-structural properties of freeze dried and spray dried samples of instant coffee powder mix, skim milk powder and coffee extract. by Scanning Electron Microscopy.

e. Powder rheology studies in spray dried and freeze dried instant coffee powder mix.

5. Testing different iron compounds in instant coffee powder mix for fortification.

a. Effect of iron compounds on sensory characteristics of spray dried and freeze dried instant coffee powder mix.

b. Evaluation of ascorbic acid as an enhancer of iron absorption from different iron compounds in instant coffee powder mix.

c. Iron binding effect of skim milk solids, coffee extract and their combination from different iron compounds in instant coffee powder mix.

6. Physicochemical changes in iron fortified instant coffee powder during storage at ambient (25 ± 2 °C) and accelerated (37 ± 2 °C) storage conditions, in two packaging material (PFP and Metalized polyester).

a. Nutritional profile of instant coffee powder mix.

b. Evaluation of physicochemical changes in spray dried and freeze dried instant coffee powder mix with storage by monitoring TBARS, free fat content, color and sensory quality.

c. Establishing microbiological safety of product during storage.

d. Evaluation of retention of fortificant during storage.
7. Establishing the bioavailability of fortified iron in instant coffee powder mix by *in vitro* study.
   
a. Analyzing individual and combined effect of irradiation and ascorbic acid on the bioavailability of iron in instant coffee powder mix.
   
b. Establishing bioavailability of fortified iron using *in vitro* dialyzable iron measurement.