The Council adopted multi-pronged and multi-disciplinary approach for advancement of nutrition research in the country. Laboratory, community and hospital-based research were integrated for evolving pragmatic approaches to combat nutritional problems confronted by the country. Highlights of research activities, achievements and new initiatives taken by the Council in the field of nutrition research during the year 2010-11 are given below.

**Intramural Research**

**NATIONAL INSTITUTE OF NUTRITION, HYDERABAD**

**COMMUNITY STUDIES**
- A study assessed the infant and young child feeding practices and undernutrition among pre-school children at district level in the state of Madhya Pradesh. The study results will help devise and implement district level intervention strategies to effectively combat malnutrition among the young children.
- Multi-component health and nutrition intervention trial among adolescents resulted in a significant increase in the health and nutrition knowledge of the adolescents. In addition, favourable changes were also observed in the perceptions and behavioural practices among adolescents. More focus should be given on promotion of healthy foods and lifestyles practices and regulated TV viewing.
- Second repeat survey was carried out by National Nutrition Monitoring Bureau on diet & nutritional status of tribal population in 9 States to assess the time trends. It revealed that there was reduction in the prevalence of severe underweight from 22.9% to 20%, stunting from 30.8% to 25.7% and wasting from 6.7% to 5.7 between 1998-99 and 2007-09, despite no significant change in the dietary intakes. Similarly, the prevalence of chronic energy deficiency among adult men and women decreased from 49.3% to 40.2% and 55.4% to 49% respectively, during the same period. However, the prevalence of overweight & obesity increased from 0.9% to 2.5% in men and 1.3% to 3.2% in women. About a quarter of adult men and women had hypertension (JNC VII).

**SPORTS NUTRITION**
- The NIN is supporting Sports Authority of India and Sports Authority of Andhra Pradesh by providing nutritional recommendations to Indian Athletes from time-to-time. Based on the studies carried out on Indian Athletes to assess the energy requirements according to their expenditure pattern, a document, “The Nutrition and Hydration Guidelines for Excellence in Sports Performance” was published in collaboration with ILSI was submitted to Director General, Sports Authority of India, New Delhi.
- Event and phase specific energy allowances were made and menu planning was done for the Indian Athletes in Commonwealth Games-2010. For the ‘weight’ category sports like boxing, weight lifting, judo and wrestling; necessary adjustments in both diet and training components were done in consultation with the coaches and trainers, so as to achieve desirable body weight and optimal performance.

**CLINICAL STUDIES**
A study has evaluated efficacy of a lactobacilli preparation on bacterial vaginosis (BV) and
vaginal immunity in healthy subjects and among patients with BV. The serum vitamin A levels were significantly lower in those with BV compared to the BV negative and intermediate flora. Similarly, serum vitamin A was significantly lower in women with cervical inflammation. Over 90% of the study population had serum zinc deficiency (<70ug/dl). Women with BV had significantly lower levels of serum Zinc compared to women with normal flora or intermediate flora.

**BASIC STUDIES**

**Micronutrient Research**

The nutrient requirements and recommended dietary allowances for Indians (RDAs) has been revised considering available evidences in the country as well as recommendations of WHO/FAO/UNU wherever necessary. The report includes newer aspects of nutrients like energy, fat and proteins and also emphasises on a few trace minerals like zinc & selenium and components like dietary fibre and anti-oxidants that were not covered earlier.

A state-of-the art in vitro human intestinal cell line model for screening micronutrient bioavailability has been established. This facility is being utilized by food industry to screen their products for micronutrient bioavailability. As a screening tool this facility can provide scientific basis for combining micronutrients for food fortification and optimal utilization with minimum interaction.

Studies on micronutrient interactions in experimental model systems suggest that iron and zinc negatively interact with each other during absorption when supplemented together. However, the extent of these interactions appears to be minimal when both of these nutrients are supplemented at an iron:zinc molar ratio of 1:<1. Further, the evidences of these interactions support the view that improving zinc status helps iron absorption and reduces the negative interaction leading to iron induced oxidative stress.

A factor having ferric reductase activity in human milk which can enhance bioavailability of iron has been identified. Further studies are in progress to understand the chemical identity of this factor.

**Ocular Biochemistry**

Evaluation of B-vitamin status among diabetic retinopathy patients revealed for the first time, an association of hyperhomocysteinaemia and vitamin-B12 deficiency with diabetic retinopathy.

Studies on impact of agents with potential use in functional foods for age related diseases revealed that rutin, a flavonoid present in many dietary agents, particularly fruits and vegetables, inhibits formation of advanced glycation end product on eye lens protein and aldose reductase of eye lens. These findings may have prospects for alleviating diabetic complications, particularly diabetic retinopathy and diabetic cataract.

Studies on rats suggest that feeding LCn-3PUFA, both at prenatal and postnatal periods is beneficial for the normal function of retina.

It was found that prolonged insulin resistance in rats causes biochemical alterations in the eye lens, which may have implications for insulin resistance mediated cataract.

**Endocrinology and Metabolism**

The effects of maternal micronutrients on the body composition, insulin resistance and macronutrient metabolism in albino rat models were studied. It was observed that a variety of micronutrient deficiencies mimicking human situations during pregnancy and lactation modulated the body composition by increasing body fat %, especially the visceral adiposity in the offspring. Further, they were associated with altered myogenesis, insulin expression and secretion from pancreatic β-islets.

A rat model for obesity viz., WNIN/Ob (sumo rat) has been developed at NIN, but the biochemical and molecular basis for this condition are not yet known. Studies based on a hypothesis that impaired insulin signaling in the brain is responsible for hyperphagia leading to obesity in the WNIN/Ob rats, revealed that impaired hypothalamic insulin signaling but not low insulin levels in the brain and the consequent failure to attain satiety may be the underlying factor for hyperphagia.

As part of the efforts to generate a database on the phenolic content of plant foods commonly consumed in India and their contribution, their health beneficial effects including anti-oxidant activity (AOA) and total phenolic content were determined. In general, phenolic content and
antioxidant activities showed a wide range of
distribution. The results also indicate that phenolics
contribute to anti-oxidant activity in some food
groups only.

**Lipid Chemistry**

Studies have been carried out in weanling 50 days
old lean and WNIN/Ob obese rats to understand
the mechanism of vitamin A-mediated control
of obesity. Results suggest that chronic feeding
of vitamin-A enriched diet ameliorates visceral
adipose tissue growth, obesity and improves insulin
sensitivity, possibly by decreasing PTP1B (protein
tyrosine phosphatase 1B) levels in soleus muscle
of obese rats.

Study on health effects of coconut (CO) and virgin
coconut (VCO) oils revealed that there were no
adverse effects with regard to various lipid parameters,
inflammatory and cardio-vascular markers in healthy
normal weight and overweight subjects.

**Stem Cell Research**

Studies have demonstrated the prophylactic effects
of pyridoxal - 5 - phosphate (PLP) towards beta cell
protection in diabeticogenic mice induced with STZ,
reflecting its antioxidant function. The beneficial
response was more with PLP pre-treatment than post
treatment. PLP could be a promising nutraceutical
molecule for treatment of diabetes, as it is easily
absorbed, is non-toxic and is a relatively low-cost
dietary supplement.

Enriching the microenvironment of pancreatic
progenitors, ductal epithelial cells (DEC) and
nestin positive cells (NPC) with PLP and RA along
with growth factors has re-created physiological
environment for expansion of beta cells and
increased in vitro generation of functional neo-
islets. Neo-islets transplanted in-vivo, rescued
hyperglycaemia and the process of regeneration /
tissue repair was evident in the pancreatic tissue of
the diabetic mice (STZ). Dietary supplementation to
the microenvironment for beta cell mass expansion
appears significant as nutritional environment
recapitulates the prenatal and early post-natal
period of the developmental process.

Cow pea derived isoflavones had beneficial
effects in protecting the bone mineralization in the
osteoporotic rat model system. Studies established
that in critical situations like osteoporosis,
supplementation with diazine and isoflavone
derived from the common foods like cow peas
could provide high content of phyto estrogen.

**Food Chemistry**

The data on the nutritive value of Indian foods
(NVIF) which is the only food composition data
available in the country is very old. A proposal was
therefore put forward to the government to generate
new Indian food composition databases, which was
sanctioned recently. Work on the project has been
initiated by procuring required instruments and
recruiting project staff. In all, 82 nutrients will be
analyzed in all the Indian food items that will be
gathered through a nationwide sampling plan.

**Molecular Biology**

Endoplasmic reticulum (ER) stress is implicated
to be the link between obesity and associated
inflammation and insulin resistance. However, the
source and nature of trigger is not well understood.
Preliminary investigations hint that the stromal
vascular fraction of the adipose tissue contributes
significantly to the inflammatory milieu compared
to that of adipocytes in the adipose tissue.

**Pathology**

The electron microscopy unit was commissioned
and 4 projects of urgent public health relevance
were successfully completed. The research
findings indicated that in diet and cancer studies,
n6 diets had deleterious effects on tumorigenesis.
It was observed that variation in dietary proteins
does not affect the toxic changes at low toxin
concentrations.

**EXTENSION & TRAINING**

The institute has produced a wide range of nutrition
education material like brochures, leaflets, posters
and CD Roms as part of different research
studies. Four educational films on ‘Adolescent
Nutrition’, ‘Dietary Guidelines’, ‘Food Labels’ and
‘Unhealthy Foods’ were developed in association
with the Educational Multi-media Research Centre
(EMMRC), Hyderabad. Several nutrition awareness
programmes were conducted and popular radio
MAJOR ICMR RESEARCH PROJECTS IN NUTRITION
Talks aimed at different groups of the community were delivered.

**FOOD AND DRUG TOXICOLOGY RESEARCH CENTRE, HYDERABAD**

The Centre, in collaboration with Bioserve Biotechnologies Pvt Ltd, Hyderabad, has developed PCR based diagnostic kits for detection of food and water borne pathogens. Primers to *E. coli*, *V. cholerae*, *V. parahaemolyticus*, *Salmonella Staphylococcus aureus*, *Bacillus cereus* were used and PCR based uniplex detection method was developed.

Commonly consumed foods in Andhra Pradesh were analysed for presence of pesticides, heavy metals, fluoride and mycotoxins. Risk assessment considering the average food intakes revealed that except cadmium, which was present at high levels in sorghum, the intake of contaminants through foods was lower than accepted daily intake (ADI).

A study conducted in Uchapally village of Nellore district, Andhra Pradesh indicated that many people who were suffering from kidney malfunction were having high serum levels of fluoride, silica and strontium. Drinking water in that area had high levels of fluoride, silica and strontium. An epidemiological study is in progress to understand the role of micronutrients in the etiology of fluoride toxicity.

Pesticide residues in foods and carbonated beverages are a public health issue. LCMS based detection of organo pesticides has been standardized.

A rapid investigation and analysis was carried out at the request of Ministry of Health and Family Welfare (MoHFW) to assess the extent of fungal and aflatoxin contamination in the rice variety PAU201 developed by PAU, Punjab that was held up in rice mills due to non-acceptance by Food Corporation of India (FCI). The study revealed aflatoxin levels well below the GOI limit of 30 ppb. On the basis of the results of this investigation and risk assessment of aflatoxin contamination, the GOI accepted the rice variety for release in the open market.

Exposure to lead present in the environment is known to be toxic. It could be more toxic for those with iron deficiency anaemiax. Using rat models, it was shown that exposure to lead in iron deficiency suppressed the immune system and had adverse effect on intestinal probiotic organisms. These effects could be mitigated by thiamine.

Under preclinical toxicology testing, safety testing of stem cells has been initiated. Acute and chronic toxicity, allergenicity of Bt cotton and Bt Okra are being carried out. PCT test of human papilloma vaccine showed no toxicity.

**NATIONAL CENTRE FOR LABORATORY ANIMAL SCIENCES, HYDERABAD**

The major focus of research was on two strains of obese mutant rats (WNIN/Ob & GR-Ob) developed at the Centre. Through the efforts of the Indo-US project titled ‘Localization and cloning of WNIN/Ob’, the search for the elusive gene responsible for obesity of these animals is going on. By detailed genotyping over 500 DNAs belonging to F0, F1 and F2 progenies with F344 rats carried out at Rockefeller University, US, mutation has been identified on chromosome 5 and further, in that chromosome, an area of 1.5 bp showing maximum polymorphism is being explored. Recently, two more aspects of these models came to light, i.e. hypertension, as well as reduction in bone mineral density, bone mineral content and bone specific alkaline phosphate. These make them ideal models for studying obesity associated with hypertension, as well as for osteoporosis. Effect of long term exercise on these animals showed benefits such as improved glucose tolerance, reduced insulin resistance and body weight and lipid profile.

The results of body composition studies carried out on rodents using non-invasive methods like TOBEC and DEXA, were compared with that of conventional invasive chemical analyses. The study showed that for hamsters and guinea pigs, DEXA is more reliable than TOBEC.

**Extramural Research**

**Micronutrient Status of Low Birth Weight Infants during Early Infancy**

A study was carried out at AIIMS, New Delhi to find the prevalence of vitamin D, retinol and Zinc in low birth weight (LBW) babies. The postnatal
growth of LBW babies lagged significantly behind the normal birth weight babies in terms of weight, length and head circumference with birth weight being the significant predictor of the same. Micronutrients levels did not have any correlation with postnatal growth.

**Abdominal obesity and its relation to plasma homocysteine & other coronary heart disease risk factors in middle aged men**

Preliminary results of an ongoing study carried out at NIN, Hyderabad have revealed the prevalence of obesity to be 44% and abdominal obesity to be 35% among the middle age men. Among the conventional CHD risk factors, hypertension is found to be significantly higher in obese men. HDL concentrations were found to be significantly lower in men with hyperhomocysteinemia compared to normal homocysteine levels. Similarly, plasma HDL-cholesterol concentrations were also significantly lower in men with higher plasma insulin levels.

**Genetic determination of non-alcoholic fatty liver disease and muscle mass in North Indians**

An ongoing study at Diabetes Foundation (India), New Delhi has reported that most of the patients diagnosed to have fatty liver had family history of diabetes. They had higher birth weight, pulse rate, systolic blood pressure, diastolic blood pressure, body weight and BMI. The values of all skin folds (subscapular, antiaxillary, suprailiac, thigh and lateral thoracic) were also significantly higher in them. About 80% subjects were reported to be Pro/Pro homozygous, 15.5% Pro/Ala heterozygous and 4.5% Ala/Ala homozygous. The observed allelic frequency of G allele of SREBP-2 gene was found to be 0.79 and that of C allele 0.21. Body weight, fasting blood glucose, ALT and hemoglobin were also significantly elevated in cases with C/C genotype.

**Food safety**

An ‘ICMR-ICAR Joint Committee for research on food safety’ has been constituted by ICMR to address various issues related to food safety. The committee will work in a two tier manner with the Technical Working Group being the 2nd level. Some of the study protocols have been formulated to answer specific queries related to food safety.

An Expert Committee on the issue of safety of consumption of vegetable juices with special reference to lauki (white gourd) juice has been constituted on request of Department of AYUSH, Ministry of Health and Family Welfare. The terms of reference of the committee include critical review of all cases of suspected poisoning of lauki juice and to recommend scientific studies to assess the toxic effects of lauki, if any.

An Expert Committee on antibiotic residues in honey has been formulated to assess the presence of antibiotics in honey samples and existing standards for the same.