# RESEARCH HIGHLIGHTS

## 1. COMMUNITY STUDIES

### 1.1 Diet and nutritional status of rural population and prevalence of obesity, hypertension and diabetes among adults of > 18 years in India: NNMB Third repeat survey

The study was carried out in 10 major states of India during 2011-12. A total of 86,754 subjects were covered for carrying out nutritional anthropometry and clinical examination to assess nutritional deficiencies. Whereas, food and nutrient intakes, obesity, hypertension and diabetes were assessed on sub-sample from 23,889 households in 1195 villages. A marginal decline was observed in the intake of all the food stuffs except, pulses, green leafy vegetables and fats and oils over decades. Also, average intake of all the nutrients had declined in the same period. The overall prevalence of underweight among preschool children had declined from 76% in 1975-79 to 49% in 1996-97 and to 41% in 2011-12. The figures for decline in stunting during the same period were 82%, 53% and 46% respectively and for wasting it were 27%, 23% and 16% respectively. The prevalence of hypertension was 22% and 21%, while that of diabetes it was 8.2% and 6.8% among men and women respectively.

### 1.2 Assessment of effects of consumption of 'Carbonated water beverages' and soft drinks on health of adolescents and young adults

The major reasons for the increased prevalence of overweight and obesity especially among youngsters could be transition in socioeconomic status, faulty nutrition (eg. sugar sweetened beverages), unhealthy lifestyles and physical inactivity levels among the population. It places these children at risk during their early and latter life. Therefore, the above study was carried out to assess ill effects of consumption of carbonated beverages. A total 2,035 young adults (men: 48.6%) in the age group of 18-35 years were covered and similarly, a total 2,257 adolescents (boys: 56.5%) were covered for assessment. Adults, consuming CWBs $\geq$400 ml/week were defined as consumers and those who were not /occasionally consuming were defined as non–consumers. The mean consumption of CWBs per day was 65ml/day and 20ml/day among adult men and women respectively. The mean intake of CWBs was 47.3ml/day and 26.6ml/day among boys and girls respectively.

### 1.3 Preparing sites for conducting effectiveness trials of microbicides in India – Multicentric study conducted in Maharastra, Karnataka and Andhra Pradesh

The study was carried out on female sex workers in the districts of E.Godavari and Khammam as a part of the multicentric study in the State of Andhra Pradesh, to assess the needs for options of prevention of HIV transmission in females and their willingness to participate in phase III clinical trials with intervention of “microbicides”. The study covered 3000 female sex workers and majority of them were rural based, married and illiterate. The mean age at first sex was about 15 years. About 27-42% of the FSWs expressed their willingness to use microbicides. The prevalence of HIV was 15.9% and 10.4% in E.Godavari and Khammam districts respectively.

### 1.4 Nutrition profile of Chenchu – A primitive tribe of Andhra Pradesh

Chenchu is one of the PTG recognized by Government of India. Generally, their dietary habits, culture and their way of life are different from the general population. Therefore, the present study was carried out during 2012 to assess their diet and nutritional status. There were no differentials observed in their food and nutrient intakes when compared to their tribal counterparts of the State. However, the prevalence of underweight, stunting and wasting was lower as compared to the general tribes of Andhra Pradesh. As observed in the verbal autopsy, the major cause of deaths among infants was premature delivery and low birth weight and among adults, it was cirrhosis of liver and accidents.

### 1.5 Assessment of nutritional status of below five year rural children and performance of ICDS functionaries in the districts of Gujarat State

The Government of Gujarat plans to develop State and District Nutrition Policy and develop plan of action for its implementation in priority districts. In this connection, NIN carried out a survey and district wise mapping of undernutrition was done. A total of 12,929 children (Boys: 52.3%) of <5 year age old were covered from the selected 10,424 households in 520 Anganwadi Centers for the purpose.

Identification of geographical areas with similar patterns of undernutrition prevalence and factors contributing for undernutrition is essential to develop and implement region-specific intervention strategies.

For this purpose, cluster analysis was carried out to identify three geographical areas/groups of districts in the state, with extent of underweight (high, medium and low) among children of <5 years as criterion.

The overall prevalence of underweight was 59% in cluster 1(red map), 46% in cluster 2 (yellow map) and 33% in cluster 3 (green map). It was observed that the proportion of children belonging to SC/ST population, joint families, illiterate parents, households having agricultural land and major occupation of parents being labour was significantly ($p < 0.01$) higher in cluster 1.

## 2. CLINICAL STUDIES

### ➢2.1 Nutritional challenges, abdominal adiposity and type 2 diabetes in Indians Parental and offspring cardio-metabolic risk: A trans-generational extension of Hyderabad Nutrition Trial (Andhra Pradesh Children and Parents Study-APCAPS)

- ➢. A cohort study was done to assess the impact of ICDS food supplement given to pregnant women in 29 villages around Hyderabad (15 under ICDS program & 14 control) on the CVD risk factors in the offspring.
- ➢ Birth weights were higher in the ICDS covered pregnant women(1987-90)
- ➢ In 2003-2005, in the first follow-up, when the subjects were13-18 year old, supplemented group were taller and had more favourable measures of insulin sensitivity and arterial stiffness (1165 adolescents).
- ➢ Second follow-up in 2009 to11 showed no difference on body composition or cardio-metabolic risk in the supplemented versus unsupplemented rural young adults.
- ➢ Current lifestyle factors - diet, physical activity, vitamin D status were the major determinants of body composition and cardio-metabolic risk during the second follow-up.

## 3. MICROBIOLOGY AND IMMUNOLOGY

### 3.1 Anticarcinogenic property of probiotic in combination with Allium sativum and NSAIDs on DMH induced colon cancer and colon cancer stem cells in rats

- ➢ Treatment with Allium Sativum, Lactobacillus rhamnosus GG and NSAIDs prevented DMH induced histopathological alterations and tumour formation in the colonic tissue; and inhibited Wnt and β-catenin expression.
- ➢ Microarray experiment demonstrated that PI3-kinase/Akt and Wnt/β-catenin pathway mediates key signals for intestinal epithelial cell proliferation and inhibition of apoptosis in an experimental model of colon cancer.
- ➢ Inhibition of Wnt and β-catenin pathways and induction of GSK-3b, which may eventually activate apoptosis and block key signals for intestinal epithelial cell proliferation appear to be the potential molecular pathway.

### 3.2 Metabolic endotoxemia and associated metabolic disorders in rats fed different diets and their relation to selective gut bacteria and changes in intestinal permeability – Phase 1 and Phase 2

i. *Effect of various cooking oils :* Effect of 10% groundnut oil, sun flower oil, palm oil, ghee and hydrogenated fats in an isocaloric diet fed to Sprague-Dawley rats for 5 months was studied. The study shows adverse effects on body composition, insulin sensitivity, bone mineral density and altered gut bacteria (lower bifidobacterial count and higher bacteroidetes) in rats fed hydrogenated vegetable fat (oil) for 5 months. Nevertheless, endotoxin levels, ASmase and reactive oxygen species were normal suggesting intact intestinal integrity that signifies other mechanisms underlying the changes observed in body composition and insulin sensitivity.

ii. *Effects of feeding high carbohydrate diet:* In the rats fed high carbohydrate diet (starch at 78%), there were changes in body composition like increased body fat%, decreased lean body mass, decreased fat free mass and decreased HDL/cholesterol ratio, increased plasma triglycerides. Rats, which received higher percentage of starch had higher Firmicutes bacteria.

iii. *Effects of feeding high fat diet:* Palmolein at 30% induced systemic inflammation and altered gut bacteria profile unfavorably. Supplementing flax seed oil significantly ameliorated many of the high fat diet induced adverse effects and increased the beneficial bifidobacteria and reduced the firmicutes level. While high fat diet is found to influence immunity, systemic inflammation and gut bacteria unfavorably, high carbohydrate diet was found to have atherogenic effects like adversely affecting body composition and lipid profile. Flax oil had a prophylactic role in reversing many of the high fat diet induced changes.

## 4. BASIC STUDIES

### 4.1 Enhancing dietary iron and zinc bioavailability in Indian children

To achieve dietary adequacy of iron and zinc by using food-based approaches, food preparation and dietary practices must be considered. As iron and zinc in cereal-pulse based habitual diet is poor in its bioavailability, their deficiencies usually occur concurrently in the Indian population. Therefore, it is not possible to meet the recommended levels of iron and zinc through a food-based approach unless diversified with fruits rich in vitamin C or flesh foods. Iron and zinc absorption simultaneously from habitual rice-based meal diversified with 100 g of guava in 16 girls and 16 boys of 13-15 years using stable isotopes were assessed. The results demonstrated that dietary diversification with guava enhanced bioavailability of non-heme iron from 10% to 20% but not that of zinc. This can form simple inexpensive intervention strategy to combat iron deficiency anemia in India. However, there is a need to assess the impact of long term consumption of guava fruit in improving iron status among vulnerable segments of the population. Additionally this study provided absorption data for computing nutrient requirements and RDA of iron and zinc in adolescent boys and girls.

### 4.2 Isolation and characterization of an iron absorption enhancer from human milk.

Iron absorption from human milk reported to be high but the factors involved remained elusive since long time. In this study for the first time we demonstrated reduction and solubilization of ferric iron and its provided evidences for its association with increased iron absorption in intestinal cells. Further, we demonstrated complementation of intestinal ferric reductase (Dcytb) with low molecular weight human milk fractions. Heat denaturation of these fractions led to inhibition of ferric iron reducing activity but not the solubilization. However, addition of zinc or citrate lyase treatment led to inhibition of both ferric iron reduction, solubilization and intestinal cell uptake of iron. These findings demonstrate that citric acid present in human milk solubilizes the ferric iron which could be reduced by other heat labile components leading to increased iron absorption in intestinal cells.

## 4.3 Stress, allostatic load and micronutrient status: Impact of dietary advice

Adolescent age group is considered as susceptible to stress, micronutrient deficiencies and allostatic load (AL) and therefore, the relationship and the impact of nutrition education intervention on these three variables were tested. The one year prospective institution- based study was carried out in 370 adolescent boys (15-19y) from 5 schools of Greater Hyderabad Municipal Corporation. One third of the participants had allostatic load and the AL index showed a positive association with controllable life events of adolescent life event stress scale. Psychological stress was associated with elevated concentrations of inflammatory marker CRP and hepcidin which did not contribute to hypoferraemia, which may be due to the influence of various factors including multiple micronutrient deficiencies.

Among the micronutrients, vitamin B-12 was positively associated with adaptive coping which needed to be probed further. Even though there was an improvement in knowledge on micronutrients after intervention, only ascorbic acid and retinol status improved while vitamin B-12 and ferritin concentrations declined, but there was no reduction in allostatic load or stress. Taken together, these results suggest that high psychological stress lead to high allostatic load. Psychological stress was found to be pro-inflammatory leading to elevated hepcidin concentrations but not hypoferremia and therefore, the low-grade inflammation appeared to not interfere with iron absorption among adolescents.

## 4.4 Assessment and validation of body composition using different techniques and development of regression models in Indian population

Body composition studies are used in a wide variety of fields including human biology, medicine, epidemiology, human nutrition and sports science. The fat content of the human body has both physiological and medical importance. Thus, the measurement of the total body composition such as fat free mass (FFM) and fat mass (two compartmental model) provides useful information.

The information pertaining to assessment of body composition using various methods and available regression equations to predict body composition were developed on western population. However, the composition and the density of FFM in different individuals limit the accuracy of these measures and influenced mainly by age, gender and ethnicity.

Since, the Indian population are different in their size and stature as compared to the western population, the existing regression equations to predict body composition based on two compartmental model (skinfold thickness and bioelectrical impedance method) developed on western population may not be applicable in the Indian context and hence, the present study was carried out to validate these methods in our population to get an accurate measures of body composition. The project work on “Assessment and validation of body composition using different techniques and development of regression models in Indian population” has been completed. The results of the study would be potentially useful in three areas:

a. *Basic Research:* The data related to body composition in different age and gender bands is being generated for the first time in the Indian context based on the validation studies.

b. *Public Health Importance:* Accurate appraisal of body composition has greater public health significance keeping in view of the increased incidence of overweight and obesity and other NCD's in the country.

c. *Translational Research:* The regression models developed based on the skin fold technique, a cost effective tool, to predict body composition suitable to Indian Population will be translated into practical applications that will help various stakeholders like policy makers, clinicians, public health workers, nutritionists, weight management professionals, athletes etc. In addition, the results of the study would also facilitate in validating and redefining the cut-off-points for Body Mass Index (BMI) and Waist Hip Ratio (WHR) suitable to Indian population

based on the degree of association with fat mass as measured using density value obtained either by underwater weighing/air displacement techniques.

### 4.5 Amino acid – Metal complexes as model for the glucose tolerance factor of yeast: Hypoglycaemic activity and therapeutic potential in diabetes; Synthesis, structure and mechanism of action in yeast and animals

To validate/ negate the hypothesis that Binary/ ternary AA – Chromium complexes could be useful as insulin like/ hypoglycemic agents in the treatment of Type ½ Diabetes. The effects of synthetic Phe- Cr, Lys- Cr and Cys- Cr complexes on OGTT in five month old male SD rats (control and STZ induced diabetic) was evaluated. The salient findings are: i) Phe–Cr complex but not others showed a significant improvement in OGT (decreased AUC glucose) albeit in only diabetic rats but not age/ sex matched controls. ii) chronic oral supplementation with Cr: $(Phe)_3$ improved glucose tolerance in a high sucrose induced rat model of insulin resistance. iii) Modulation of insulin signaling but not altered secretion of insulin during OGTT appears to underlie Chromium Phe complex mediated alleviation of diet-induced insulin resistance. iv) The skeletal muscle from Cr (D-phe) 3-treated rats had enhanced Akt-phosphorylation and membrane translocation of GLUT4 compared to untreated diabetic controls appear to suggest that nutritional supplementation with chromium complexes may have potential therapeutic value in alleviating or preventing insulin resistance and the associated type-2 diabetes and metabolic syndrome.

### 4.6 IGF1and BDNF signaling in the brain of Wistar NIN obese mutant rats during ageing: Effect of calorie and micro-nutrient restrictions

To validate/ negate the hypothesis that modulation of brain IGF1/ BDNF signaling and/or greater oxidative stress underlie accelerated ageing in WNIN–Ob rats, studies were conducted in WNIN/Ob and corresponding control rats. The salient findings of these studies are : I) Altered IGF1 and BDNF levels and signaling in brain and / or high oxidative stress could underlie accelerated ageing in the obese mutant rats of NIN. ii) Significant changes were observed in plasma CRP levels in WNIN/Ob rats as compared to controls albeit at 12 months of age but not earlier. iii) Increased expression of glial fibrillary acidic protein (GFAP) in the hippocampus of 6 months old WNIN Ob rats compared to controls whereas, at 12 months of age GFAP expression was lower in WNIN/Ob than controls probably suggesting that it could underlie impaired synaptic plasticity and hence brain ageing in WNIN/Ob rats. iv) At 12 months of age WNIN/Ob rats showed higher ($p<0.001$) expression of ORX-A and ORX-A positive neurons in the brain than controls. Considering the importance of orexin in energy balance, feeding, wake–sleep cycle, stress response, aging, reproduction etc, the increased ORX-A expression could be another factor underlying accelerated ageing reported earlier in WNIN/Ob rats.

### 4.7 Functional assessment of adult human pancreatic islets following autologus transplantation

The study used these immunoisolatory devices (Theracytes) to test the viability and functionality of monkey islets, in this devices following auto-or allo-genic transplantation in monkeys. The animal experiments were performed at National Centre for Laboratory Animal Sciences, National Institute of Nutrition, Hyderabad which has an approved primate animal facility.Islets remain viable and functional for 12 months in pancreatectomized nonhuman primates in both autologous and allogenic islet transplantation. Allo transplanted islets were viable and functional in the absence of an immunosuppression.

Poly tetra fluoro ethylene devices (Theracyte) has engraftment potential to sustain islet with functional /insulin secreting responses. Vascularization was more extensive in the neck region and explants obtained from interscapular region denoted it to be relatively a better site for implantation as compared to the thigh.

The promises of transplantation without the immunosuppressive drugs towards the maintenance of Glycemic status achieved by bio-compatible devices (theracyte membrane) in higher model system such as Non-human primates. While the obtained results are indeed encouraging, further studies are required in this regard to evaluate the curative potential of macroencapsulated islets using diabetic models.

### 4.8 Establishment of propagable cell lines from pancreas and adipose tissue of embryo and adult WNIN obese rats (WNIN/Ob & WNIN/GR-Ob)

WNIN Mutants rats (WNIN/GR-Ob and WNIN/Ob) were used as the model to study the adipose and pancreatic stress/inflammation as a phased gene expression studies, markers of stem cells, and their lineage commitment to form adipocytes or islets using primary cultures stromal stem cells /ductal epithelial cells.

Data showed an alterations in tissue milieu (to adapt to physiological shifts happening in conditions of obesity and metabolic syndrome (MS) both during early and prolonged phase of obesity/insulin resistance (IR) have been documented, though mechanisms leading to such state have remained elusive so far. Participation of several confounding factors that collectively co-precipitates for a state of profound inflammation in target tissues being appreciable in Mutants> lean > Controls and gets worsened as the animals age were showed.

These factors include, hypertrophy, macrophage infiltration (CD11b/TNF / IL6), apoptosis, adipose/ -cell vacuolation, hyperinsulinemia (HI), stress markers (RL-77/HSP104/TBARS) all of which correlated well with indices for Obesity (2-3 fold), IR (1.5-3fold) and HI (2-3 fold). Further, supportive data was also obtained from *in vitro* studies using stromal cells /islet cell cultures amongst phenotypes. Complementary data obtained from BM-MSCs also supported for the state of disease memory in Mutants as compared to Lean and Control.

Studies both *in vitro* and *in vivo* amongst phenotypes does advocate for the alteration in stem cell milieu during the state of meatobolic lesions depicted in mutants with obesity/IR /IGT/ HI, associated with pathophysiological conditions (adipose tissue, pancreatic, BM-MSCs), portraying features of pre-diabetic/T2D as compared of human scenario.

### 4.9 Characterization of active principles and mechanism of action of dietary aldose reductase inhibitors and antiglycating agents: (v) Isolation and characterization of -glucogallin as a novel aldose reductase inhibitors from *Emblica officinalis*.

Aldose reductase (ALR2) is a major target for the development of therapies to treat diabetic complications. The bioassay-guided isolation and structure elucidation of 1-O-galloyl-b-D-glucose β-glucogallin, a major component from the fruit of the gooseberry that displays selective as well as relatively potent inhibition of ALR2 *in vitro* was described. Further, β-glucogallin effectively inhibits sorbitol accumulation under hyperglycemic conditions in an *ex-vivo* organ culture model of lenses excised from transgenic mice over-expressing human ALR2 in the lens. This study demonstrates that, molecules from natural products such as β-glucogallin as therapeutic leads in the development of novel therapies to treat diabetic complications.

### 4.10 Impact of agents with potential use in functional foods on biomarkers for induction of age related diseases

Accumulation of intracellular sorbitol due to increased aldose reductase (ALR2) has been implicated in the development of diabetic complications. The inhibition of ALR2 by ellagic acid (EA) a bioflavonoid present in many dietary sources was described. EA inhibited ALR2 with an $IC_{50}$ of 46 nM in a non-competitive manner. Further, EA is relatively more specific towards ALR2 over other member of aldo-keto reductase family. Molecular docking studies substantiate these findings. Further, EA suppressed sorbitol accumulation in human erythrocytes, rat lens and rat retina under high glucose conditions. Finally, significance of EA

was demonstrated in terms of prevention of loss of lens transparency under high glucose conditions in *ex vivo* conditions. Together, these observations suggest that EA holds a therapeutic promise to prevent or treat complications of diabetes.

### 4.11 Potential role of dietary nutrients vitamin A and polyunsaturated fatty acids (PUFA) on regulation of development and /or control of obesity using a genetic obese mutant rat model (WNIN/GR-Ob)–Nutrient-Gene Interaction

Chronic feeding of vitamin A-enriched diet (129mg per kg diet) to glucose-intolerant obese rats of WNIN/GR-Ob strain improved the hyperglycemia, glucose tolerance and muscle insulin sensitivity. Further, qRT-PCR data suggest the transcriptional regulation of the various important lipogenic pathway and adipokine genes of visceral adipose tissue and it was well corroborated with the increased adiposity and insulin sensitivity observed in these obese rats. Importantly, it appears that vitamin A-mediated improvement in muscle insulin sensitivity in obese rats is due to regulation of phosphorylation status of glycogen synthase, which in turn resulted in increased glucose uptake and glycogen synthesis.

### 4.12 Abdominal obesity and its relation to plasma homocysteine and other biochemical CHD risk factors in middle aged men

With a highest (58%) prevalence of hypertension in men with abdominal obesity measured by waist circumference (WC) $\geq$90cm and with a significant ($p<0.001$) positive correlation of the four obesity measures (BMI, WC, WHR and % of BF) with systolic and diastolic blood pressures, regression analysis shows that WC alone predicts systolic and diastolic blood pressure in the present study men.

With a 25 % prevalence of insulin resistance, it was observed that, a graded increase in insulin resistance from lower $\geq$18.5-<23), to medium $\geq$23.5-<27.5 and to higher range of BMI$\geq$27.5 in the present study men. Regression analysis shows that BMI predicts insulin resistance in the present study men. Regression analysis shows that the inflammatory marker, C-reactive protein levels were found to be positively associated to waist circumference and % of body fat.

With a 28% prevalence of hyperhomocysteinemia ($\geq$15µmoles/L) in the overall study population, vegetarian men had doubled the prevalence of hyperhomocysteinemia compared to non-vegetarian men.

In relation to body composition, in a similar range of BMI, men with high WC had significantly ($p<0.05$) higher plasma homocysteine concentrations than the men with normal WC (<90cm). With a 50% prevalence of low HDL-cholesterol (<35mg/dl) levels in the present study, men with low HDL_cholesterol levels were found to have significantly ($p<0.05$) higher plasma homocysteine concentrations than men with normal HDL-cholesterol levels. A negative correlation observed between plasma homocysteine and HDL cholesterol levels is an important finding of the present study.

## 5. EXTENSION & TRAINING DIVISION

### 5.1 Evaluation of nutrition reports based on research studies in leading Indian newspapers

Six newspapers including English and Telugu dailies were analysed to study the pattern of their coverage of nutrition related news/ features. It was found that about 70% of the items reported were based on secondary sources and only 30% were quoted from original source, out of which, very few based their reports on peer reviewed journals. Some of them carried the reports of public relations departments of food/ pharma industries. Emphasis was placed on 'newsworthy' pieces of information, especially those which run contrary to current health recommendations. Sample characteristics, study methodology, and study limitations are not routinely reported in the newspapers. The study further stresses the need for synergetic efforts between journalists covering health topics and experts in the field of diet and nutrition in order to avoid inaccurate information to the readers.

## 6. FOOD AND DRUG TOXICOLOGY RESEARCH CENTRE

### 6.1 Creation of demand for millet foods through PCS value chain

Sorghum has high levels of both soluble and insoluble fibre. Fibre is known to slow the release of glucose and has beneficial effects in diabetics who have exhibit high increase in post prandial plasma glucose levels. The newly developed cultivars have higher levels of protein. A project was initiated to create demand for millet foods through PCS value chain with a view to commercialize several products of sorghum. The studies revealed that products prepared from sorghum were organoleptically on par with similar recipes prepared from wheat or rice. They were acceptable to children also. Consumption of sorghum resulted in better control of hyperglycemia. Further, the glycemic index of some of the products were lower than recipes prepared from other cereals.

### 6.2 Value chain on commercialization of maize products

The human consumption of maize is less than 10% of its produce. National Agricultural Innovative Project, a division of ICAR has initiated project to develop innovative products of maize for commercialization. Two varieties of maize were used to prepare selected food items and evaluated for acceptability and management of blood glucose in Type 2 diabetics. The studies indicated that QPM variety of maize had better quality of protein than Nityashree. Regular consumption of maize based foods had significantly lowering effect on levels of glycosylated hemoglobin although they were not low in glycemic index and load. The resulting beneficial effect could be due to the fibre content in the grain.

### 6.3 Micronutrient profile of population residing in fluoride endemic areas

Fluorosis is caused due to chronic exposure to high fluoride through water and food. The condition is aggravated by malnutrition. Water in endemic fluoride areas have been reported to have low levels of some minerals like Ca, Mg and Cu. Micronutrient deficiencies have been implicated in the etiopathogenesis of fluorosis. A study was conducted to understand the role of micronutrients in fluorosis.

The levels of magnesium, selenium and zinc were significantly higher in individuals from areas endemic for fluorosis. Thyroid function test showed that levels of T3 was significantly higher in people belonging to areas where fluorosis exists. There were no changes in hematological parameters. Overall, the survey demonstrated that adverse effect due to exposure of high fluoride through water was less in the population studied due to their good nutritional status.

### 6.4 Assessment of pesticide exposure and various cancers among agricultural farming community Guntur District

Most of the farmers in Guntur district use organophosphote and synthetic pyrethroid pesticides to control pests on chilly and cotton. Incidence of certain types of cancers have been reported from the farming community. Literature evidence supports association of lymphoma, leukemia and breast cancers with exposure to pesticides. Therefore, a project was taken up to understand the role of farming practices, exposure to pesticides and cancer incidence. The results revealed that 89 subjects out of 670 cancer subjects showed presence of P, P'DDE and four of them had high levels. The survey also indicated that most of the farmers were not practicing proper spraying methods or adopting precautionary measures prior to/immediate after spraying.

### 6.5 Assessment of dietary intakes of select chemical and processing induced contaminants in various socio economic groups in Hyderabad

Levels of an exact intake of nutrients and exposure to contaminants through diet hitherto has been reported based on calculations done using raw food components. However, the actual exposure can be assessed only by calculating the intakes and exposure based on foods following processing/cooking processes.

The National Nutrition Monitoring Bureau (NNMB) provides information on food consumption of non processed foods and it is also rural based survey. In the present study, information on foods consumed (conventional and processed) by high income, middle income and low income was collected. Foods were cooked as is done in culinary practice.

The data showed that the intakes of conventional and processed foods differed between different socioeconomic sections among the Hyderabad population. Intake of trans fat through selected bakery items and other sources were less than 1% of energy. Dietary exposure to lead and cadmium were below the respective provisional tolerable weekly intakes (PTWIs). Estimated dietary exposure to pesticides were within the acceptable daily intakes.

### 6.6 Evaluation of herbal and nutraceutical product for anti-atherosclerotic activity

Earlier research findings have demonstrated anti-atherosclerotic activity (in-silico, *in-vitro* & *in-vivo*) of Poly Herbal Nutraceutical Formulation (PHN). The current studies suggest that prevention of foam cell formation due to possibly attenuation of CD36 cascading pathway, which promote entrapment of lipid laden foam cells due to ROS, inflammation and oxidized LDL (oxLDL) activation.

## 7. NATIONAL CENTRE FOR LABORATORY ANIMAL SCIENCES

### 7.1 Establishment of baseline values of body composition and blood pressure in different species of laboratory animals maintained at NCLAS – A Study on mice strains

Body composition analysis reveals the nutritional status and general well being of an individual. In the past, body composition of experimental animals was determined by carcass chemical method, necessitating the sacrifice of animals. But, in recent times alternative non-invasive measures like total body electrical conductivity (TOBEC) and dual X-ray absorbtiometry (DXA) have emerged, which allow repeated individual measurements without sacrifice of animals.

Progressive changes in the body composition of three commonly used mice strains in nutritional and toxicological research VIZ., Swiss albino, BALB/C and $C_{57}BL_6J$ were analyzed by TOBEC initially and subsequently by DXA compared with chemical method and parameters like lean body mass (LBM), fat, fat %, fat free mass were determined. It was observed that the TOBEC analysis did not correlated with the carcass analysis for mice.

DXA is superior, constant and correlated with chemical method and found to be more appropriate. Swiss albino mice had significantly higher body weights compared to BALB/C and $C_{57}BL_6J$. This was more pronounced in males than females. LBM is reduced, fat and total fat percentage was found to be more in Swiss albino than the other two strains. Similar pattern of results were obtained in terms of their food intake and clinical chemistry parameters.

In conclusion, the findings are unequivocally showed that for body composition analysis of lab animals like mice, hamsters, guinea pigs and rabbits, DXA is superior and constant in comparison with all methods, for rats, TOBEC could match that carcass analysis.

## 8. PRE-CLINICAL TOXICOLOGY

### 8.1 Pre-clinical efficacy (IBD, Anti-inflammatory) and safety evaluation of Novel Peptide Genopep 4 (Issar 4)

Inflammatory bowel disease (IBD), a major health problem in the developed world which comprises i) ulcerative colitis (UC) and (ii) Crohn's disease (CD) a chronic relapsing and remitting inflammatory disorders of the gastrointestinal tract. The Centre has evaluated a beneficial role through immune regulatory activity and anti inflammatory properties of IS-217 having similarities like interleukin10 (IL-10).

## 8.2 Pre-clinical toxicology study of Recombinant Interferon beta-1b (IFN 1b)

A private organization had developed Interferon beta –1b using recombinant DNA technology with an intention to promote it for the treatment of multiple sclerosis. The Pre-clinical toxicity investigation (Acute and sub–chronic) has been conducted as per DBT/Schedule Y of DCGI guidelines and report submitted for clinical trials through RCGM and DCGI.

## 8.3 Pre-clinical toxicity evaluation of Transgenic Cotton (Cry1ac Event-1and Cry1ecevent-24)

The Bt cotton with stack genes Cry1Ac (event-1) and Cry1EC (event-24) have been developed by one of the private companies It was evaluated for pre-clinical toxicology as a part of Bio-safety norms of DBT.