

## CHAPTER 23

### HOME SCIENCE

#### Doctoral Theses

01. ANSARI (Zoha)

**Feasibility Studies on Microencapsulation of Bioactive Compounds Extracted from Potato Peels (Agro-Industrial Waste).**

Supervisor: Dr. Sangeeta Goomer

Th 25971

#### *Abstract*

Potato peels, a zero-value agro-industrial waste holds a tremendous potential to be used as a source of nutrients and natural antioxidants to substitute unhealthy artificial antioxidant additives used in food and pharmaceutical industries. In the present study, peels of two varieties of potato tuber i.e., red skinned “Lady Rosetta (LR)” and brown skinned “FL-1533” used for chips manufacturing in industries were explored for their antioxidant and antibacterial potential. Antioxidant activity of the peel extracts was estimated by DPPH and FRAP assay. Total phenolic content and flavonoid content was estimated by Folin-Ciocalteu assay and Aluminium chloride colorimetric assay respectively. The most appropriate drying method among (sun, freeze and shade drying) was identified for both varieties of peels in order to formulate the dried peel powder with maximum retention of bioactive compounds and select the best peel variety for further analysis. Four different extraction methods (maceration with shaking at 37°C; maceration without shaking at room temperature (18°C), thermal decoction and ultrasound assisted extraction (UAE) were compared for maximum extraction of antioxidants from dried peels. Phenolic and non-phenolic compounds responsible for antioxidant and antibacterial activity of sun dried LR peel extract were identified by LCMS. Further, crude extract was encapsulated by freeze drying using gum arabic (GA) and maltodextrin (MD) blend as coating agent on the basis of pre-liminary trial. Extraction conditions of the selected method and encapsulation variables (core: coating and GA:MD ratio) were optimized by response surface methodology (RSM). The crude and encapsulated extract powder obtained using optimized conditions were analyzed for their physico-chemical (solubility, moisture, yield, antioxidant activity, encapsulation efficiency, anticancer activity), structural (morphology, FTIR, XRD), thermal properties (heating stability, thermogravimetric analysis (TGA) and differential thermal analysis (DTA)) and storage stability at room temperature for 30 days. The release kinetics of encapsulated powder was studied in drinking water for further incorporation in commonly consumed water-based foods. The incorporation level of encapsulated powder (5, 10 and 15%) was optimized to obtain the enriched products with maximum antioxidant activity, phenolic content and sensory scores. Proximate analysis results showed that potato peels were rich source of protein (P) and minerals i.e., Calcium (Ca), Phosphorus (P) and Iron (Fe) with higher amount found in LR peels (P:10.65%, Ca: 9.45 g/kg, P: 5.10 g/kg) than brown colored FL-1533 peels (P:8.5%, Ca:8.69 g/kg, P: 4.25 g/kg). Fe content was higher in FL-1533 (2.05 g/kg) than LR (0.56 g/kg) variety. Sun drying resulted in the highest phytochemical yield, phenolic content and antioxidant activity for both the varieties of potato peels followed by freeze drying and shade drying. Lady Rosetta peel variety showed higher antioxidant and antibacterial activity than brown coloured FL-1533 variety. Both drying method

and peel variety showed significant individual and interactive effect ( $p \leq 0.05$ ) on antioxidant and antibacterial activity of dried peel samples. Antibacterial assay showed greater tolerance of gram-negative strain *E. coli* against phenolic extracts than gram positive strain *Bacillus subtilis*. Only sun dried „Lady Rosetta“ peel extract exhibited antibacterial activity against gram negative bacteria. Strong positive correlation ( $>0.6$ ) at  $p \leq 0.05$  was observed between phytochemical content and antioxidant and antibacterial activity of potato peels. The highest extraction yield, phytochemical content and antioxidant activity of sun dried LR peels was obtained with maceration in shaker and lowest amount obtained with UAE attributing to its sono-chemical effects. The optimal extraction conditions of maceration in shaker found by RSM for sun dried LR peels were 90% ethanol concentration, 50°C temperature and 1:20 solid: solvent ratio. The bioactive compounds identified in peel extract by LCMS were phenolic acids (ferulic acid, p-coumaric acid, cinnamic acid), flavonoids (quercetin, rutin), glycoalkaloids (solanine, chaconine), antimicrobial compounds (Benzaldehyde, cinnamaldehyde, benzothiazole), anthocyanins (3-Methoxytyramine- betaxanthin), essential amino acids (Histidine, arginine, leucine, isoleucine), fatty acids (Palmitoleic acid, Oleic acid) and vitamins (Biotin, choline). The preliminary trial showed better encapsulation efficiency (90.08%) in blend of maltodextrin and gum arabic than when used as single wall material (58.32% for gum arabic and 24.72% for maltodextrin). The optimized core: coating and gum arabic: maltodextrin ratio obtained were 1:22 and 92:8 respectively. IC<sub>50</sub> value for cytotoxic activity of crude peel extract against cervical cancer cell lines, Hela and SiHa was  $69.36 \pm 1.6 \mu\text{g/ml}$  and  $16.88 \pm 0.17 \mu\text{g/ml}$  respectively. Storage (30-35°C/ 30days) and heating stability (60°C/8hrs.) of both crude and encapsulated extract powder showed better retention at room temperature and 3 higher resistance of encapsulated powder to heating than crude extract. The morphology of encapsulated powder was amorphous in nature with very low degree of crystallinity. Functional groups corresponding to the peaks obtained in FTIR (Fourier-transform infrared spectroscopy) spectra of microcapsules indicated the interaction between core and coating agent and presence of both wall material and peel extract in microcapsules. Thermogravimetric and differential thermal analysis of both crude and encapsulated extract powder at temperature range of (0-600°C) showed excellent thermal stability of encapsulated powder with greater weight loss observed in crude extract confirming the protective effect of encapsulation. A biphasic release pattern (initial burst effect followed by sustained release) was observed in release of antioxidants from encapsulated microparticles in drinking water for 48 hrs. Diffusion and swelling of wall materials were identified as the governing release mechanism by release kinetics models. Overall acceptability score of 7-8.5 was obtained at concentration of 10% in *chapati*, 15% for spice sprinkler, 5% for sattu beverage and 10% for instant vegetable soup. Spice sprinkler enriched with 15% level enhanced the antioxidant activity of the spices by 24.23%. Further, shelf-life study of food products enriched with encapsulated antioxidant powder needs to be explored.

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02. ARORA ( Beena)  
**Nutritional Profile and Quality of Life in Patients Undergoing Different Bariatric Surgery Procedures.**  
Supervisors: Dr. Anupa Siddhu and Atul N. C Petters  
Th 25969

#### Abstract

Bariatric Surgery is a relatively new speciality in India and thus there is lack of data about nutritional profile of patients undergoing this surgery. Data is also lacking in terms of expected improvement in QOL. The major objective of this study was to assess the nutritional profile and quality of life of patients undergoing different bariatric surgery procedures (LSG and GBP including RYGB, MGB/OAGB and DJB), in short term and long term. It was a hospital based, observational study and was conducted in two phases, short term (prospective, longitudinal) and long term (retrospective, cross-sectional) at Indraprastha Apollo Hospitals, Delhi. For short term phase total 76 Indian patients, aged 18 to 60 years (male = 60.5%, female = 39.5%) underwent bariatric surgery between February' 2018 to August'2019 were recruited with purposive sampling at 0 months with informed consent and followed up at 3, 6 and 12 months post-surgery. For long term phase data was collected retrospectively from surgeon's database for patients who underwent bariatric surgery  $\geq 2$  years ago and did not have any reversal or redo procedure. Secondary data was collected for baseline and 2, 3, 4 and 5 years follow-up. QOL for long term was assessed through an exploratory phase, where we analyzed QOL of patients (n=43) as on date who were operated  $\geq 2$  years ago.

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03. ARORA (Charu)  
**Efficacy of intensive Weight loss Intervention on Metabolic, Anthropometric and Ultrasound Parameters among adult Indian Non Alcoholic Fatty liver Disease (NAFLD) Patients: A Randomized controlled Trail.**  
 Supervisors: Prof. (Dr.) Anita Malhotra and Dr. Piyush Ranjan  
Th 26499

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04. ARORA ( Garisha )  
**Cosmopolitanism, Self-Esteem, Importance to Appearance, and Clothing Interest among Collegiate Students: A Relationship Analysis.**  
 Supervisor: Dr. Jyoti Aggarwal  
Th 25972

#### *Abstract*

Globalization has led to mixing of cultures, varied exposure across the globe. Travelling, migration, media exposure, all have contributed to major changes among individual behaviour irrespective of the country. India is one of the top participants in this change. Indians are also imbibing cosmopolitan ideology, and becoming more fashion conscious, conscious towards their self, physical appearance and involved in fashion related activities through clothing. Limited literature is available on the relations of sociopsychological constructs viz: Cosmopolitanism (COS), Self-Esteem (SE), and Importance to Appearance (IAPP) with clothing interest in its more abstract form (i.e., considering five dimensions of clothing interest together). The five dimensions selected to measure clothing interests were Interest in Clothing as Experimenting with Appearance

(ICEA), Innovative Style of Clothing (ISC), Desire for Unique Clothing (DUC), Heightened Awareness of Clothing (HAC), and Interest in Clothing as Enhancement of Individuality (ICEI). Based on symbolic interaction theory, social comparison theory, vanity theory, and cosmopolitanism concept, the present study aims to confirm the causal relationship between COS, SE, and IAPP with clothing interest amongst college students of Delhi, (18-24 years). The present study also tested the higher effects (mediation effect) of COS and IAPP: COS as a mediator of SE in relation to clothing interest; IAPP as a mediator of COS in relation to clothing interest and IAPP as a mediator of SE in relation to clothing interest. A structured questionnaire was developed using research articles and marketing scale books. Based on operational definitions a total of nine constructs were selected to prepare the final questionnaire. To measure each construct standardized scales were selected. The tool was pre-tested on a sample of 30 students, where reliability (construct-wise) was computed using Cronbach's alpha value. After ethical clearance from the Institutional ethics committee, final structured questionnaire was used for data collection, which was done using convenience sampling method from a total of 14 (7 government and 7 private) colleges of metropolitan city, Delhi, India. Sample size was calculated using three methods (using mean & S.D. of pilot testing data; G\*power; and Barclay's approach). Maximum sample size out of the three methods was selected, i.e., 877. Mixed approach was used to collect the data (i.e., both online and offline mode). After data collection, cleaning and removing multivariate outliers, the final sample size for analysis was 1039. Descriptive analysis was performed, where frequency and percentage of demographic variables and each construct were calculated. To test the proposed hypothesis Structural Equation Modelling (SEM) technique was applied, where Confirmatory Factor Analysis (CFA) approach (measurement model assessment) was used to check the reliability and validity of the tool. To test the proposed hypothesis, path analysis (structural model assessment) was performed using Smart PLS3. Gender was used as a control variable. Results indicated no reliability and validity concerns.

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05. ARORA (Priyanka)  
**Dietary and Lifestyle Factors Influencing Pregnancy Outcome of Overweight/ OBESSE Women Belonging to Upper SES Residing in North-West Delhi.**  
 Supervisor: Dr. Bani Tamber Aeri  
 Th 25975

#### *Abstract*

Keeping in mind the vulnerability of obese and overweight women towards adverse pregnancy outcome, the present study was planned to identify the dietary and lifestyle related factors affecting the pregnancy outcome of affluent overweight/obese pregnant women belonging to upper socio-economic strata (SES) of North-West Delhi. This was a longitudinal study which was conducted among **312 pregnant** women enrolled from two private antenatal clinics located in North-West Delhi. The subjects were enrolled purposively and only those subjects who gave their written permission to participate in the study were finally included in the study. The study protocol was reviewed and approved by the Institutional Ethics Committee of the Institute of Home Economics, University of Delhi, dated 3<sup>rd</sup> May 2018 (IHE/2018/1139). In the present study, enrolment of all the subjects was carried out before 12 weeks of gestation, in fact, more than half of the subjects (53.8%) were enrolled very early in their pregnancies i.e., less than 6 weeks of

gestation; whereas 46.2% of subjects were enrolled between 6<sup>th</sup> to 12<sup>th</sup> week of gestation. As per previous literature, height and weight of the subjects measured at their first antenatal visit (before 12 weeks of gestation) may be used to compute their pre-pregnancy BMI. Based on pre-pregnancy BMI, subjects were categorised as obese (OB), overweight (OW) and normal weight (NW). On stratification based on WHO-BMI guidelines (1995), 12.5% of study subjects were OB followed by 29.8% who were OW and 57.7% who were NW subjects. On other hand, stratification based on pre-pregnancy BMI based on the Asian Indians by Misra et al (2009), indicated that more than two-fifth of subjects (42.3%) belonged to OB category whereas OW and NW categories comprised of 28.8% of subjects each respectively. For the present study, the division of subjects based on the Asian Indians by Misra et al (2009) classification was considered as more relevant and **thus these cut-offs have been used for classifying the three groups of study**. Mean BMI among OB, OW and NW categories was 28.79+3.45kg/m<sup>2</sup>, 23.97+0.6kg/m<sup>2</sup> and 21.23+1.28kg/m<sup>2</sup> respectively. Henceforth, all results were analysed and discussed based on the three groups of pregnant women. Data related to maternal parameters were gathered at <16<sup>th</sup> week (base-line), 18<sup>th</sup>-20<sup>th</sup> week (mid-term), >32<sup>nd</sup> week- childbirth (term) and post-delivery (<8<sup>th</sup> week).

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Th 26500

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 Supervisors: Dr. Deepali Rastogi and Dr. Ritu Mathur  
Th 26497

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08. JAIN ( Prerna)  
**Post Industrial Waste of Indian Garment Industry-Insights and Reverse Logistics.**  
 Supervisor: Dr. Charu Gupta  
Th 25970

#### *Abstract*

Depletion of natural resources and deteriorating natural environment has become a matter of concern and focal point for all countries around the world. It is imperative to sensitise, strategise

and be actionable in managing waste for the survival of ecological sustenance. The textile and apparel industry has played a detrimental impact in both manufacturing and consuming end by generating gigantic proportions of various kinds of post-industrial and post-consumer textile waste. The solutions are multidirectional, and a midpath between sustainability and mass production is necessary to address this most important burning issue which is suffocating the environment- be it natural or industrial. A strong, productive and value- based reverse supply chain system to meet the ethos of a circular economy can pave the way to minimize some of the environmental footprints. In the system of circular economy, resources are kept in a loop as much as possible so that their values can be maintained during use, and at the end of utilization. Thus resources can be repurposed into new products for generations (Shirvanimoghaddam et al., 2020). Reverse logistics is the “Process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal” (Rogers & Tibben-lemcke, 1998). Thus reverse supply and recovery of used, waste or discarded products to achieve circular economy is called reverse logistics and all the processes and stakeholders involved in reverse logistic comprise a reverse logistics system.

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09. KAMBOJ ( Preeti )  
**Consumption Pattern of Foods High in Fat, Salt and Sugar Among Adolescents form Different Socio-Economic Groups of Urban Delhi.**  
 Supervisors: Dr. Neena Bhatia and Dr. G.S. Toteja  
Th 25974

#### *Abstract*

Foods high in fat, salt and sugar are deficient in proteins, vitamins, phytochemicals, minerals, and dietary fibre but rich in fat/salt/sugar. Limited Indian data is available on the consumption pattern of HFSS foods among adolescents. The present study assessed the HFSS foods consumption pattern, nutritional status, physical activity behavior, blood pressure (BP) and obesogenic food environment of 577 adolescent girls and boys, aged 11-18 years, belonging to different socio-economic status groups in urban West and Southwest Delhi. Ethical clearance was obtained from Institutional Ethics Committee, Lady Irwin College, University of Delhi. Information was collected on socio-economic and demographic profile; HFSS foods consumption pattern (using semi-quantitative food frequency questionnaire (SQ-FFQ)); usual and present dietary intake (using 24-hour dietary recall (24 DR)); lifestyle and physical activity behavior; and obesogenic food environment. Anthropometric assessments included height, weight, mid-upper arm circumference (MUAC) and waist circumference (WC). Blood pressure was also measured. The mean amount spent per day on buying HFSS foods was INR 36.7±50.8. The most consumed category of HFSS foods more than once a week based on SQ-FFQ was *namkeen* (73.4%) followed by caffeinated beverages/ sugar-sweetened beverages (SSBs) (73.2%). Highest mean intake was reported for caffeinated beverages/ SSBs (86.8±100.0 ml). The highest mean intake based on 24DR was reported for *namkeen* (30.5±46.7 g). According to WHO growth reference, 19.6% and 4.2% adolescents were moderately and severely stunted (height-for-age), 13.3% and 4.6% were moderately and

severely thin (BMI-for-age), 20% and 6.3% were overweight and obese (BMI-for-age) respectively. Using MUAC cut-offs <5<sup>th</sup> percentile and >25 cm, 4.8% and 12.2% adolescents were undernourished and obese respectively. Around 11.5% adolescents had WC>70<sup>th</sup> percentile and 20.7% had waistto- height ratio $\geq$ 0.5. Around 6.8% adolescents had prehypertension/ high normal BP, 6.3% had stage 1 hypertension/ grade 1 hypertension and 2.1% had stage 2 hypertension/ grade 2 hypertension. Moderate-to-vigorous intensity physical activity $\geq$ 60 minutes per day was performed by 41.0% and 49% had screen time $\geq$ 120 minutes per day. Only 37.6% adolescents slept for the recommended duration. Approximately 73% visited parks/open spaces for performing physical activity.

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10. KOHLI (Sahiba)  
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 Supervisor: Dr. Ravinder Chadha  
Th 26498

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11. MALIK (Anku)  
**Body Composition, Bone and Muscle Strength of School Children (8-14 Years) Born Low Birth Weight at Term.**  
 Supervisors: Dr. Geeta Trilok-Kumar and Ranjana Mahna  
Th 25976

*Abstract*

India is facing an epidemic of obesity, that is unfortunately now encompassing children. A high burden of Low Birth Weight (LBW) coupled with overnutrition later in these children has added to the problem of undernutrition. This is often referred to as a dual burden of malnutrition which is prevalent in India (Prentice, 2018). The coexistence of undernutrition and overnutrition has been explained by Developmental Origin of Health and Disease (DOHaD) hypothesis. However, there is scant literature on the impact of being born full term LBW on physiological health outcomes in Indian children aged 8-14 years. The present study attempts to therefore fill this gap by evaluating the effect of term end LBW on body composition and bone and muscle strength of children. These children were also assessed for their dietary intake. Six hundred and fifty-nine full term LBW children (gestation >37 weeks; birth weight: 1.8 to 2.4 kg) from underprivileged areas of Delhi, NCR belonging to the Delhi Infant Vitamin D Supplementation (DIViDS) cohort were traced and investigated in the present study. Since the residence areas of LBW children were dispersed across Delhi NCR, tracing was initiated using telephonic calls as the primary approach and home visits as the secondary. Children born full term with normal birth weight (NBW) (gestation >37 weeks; birth weight: 2.5 to 4.0 kg), residing in the same demographics were also enrolled as controls for comparison (n=51). A substantial proportion of NBW children (n=32) were siblings of the LBW children. The parameters measured in these children included

anthropometry (weight, height, circumferences of mid upper arm, waist and hip, skinfold thickness at tricep and subscapular) and body composition by two compartment model including deuterium dilution test and bioelectrical impedance analysis using Tanita, bone strength using quantitative ultrasound (QUS). Muscle strength of upper and lower limbs were assessed using hand grip strength and long jump from standing start, respectively. A subset of LBW children (n=139) were also assessed for their dietary intake using a two-day dietary recall method.

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12. RATHI (Komal)

**Complementary Feeding Practices of Mothers of Infants and Young Children from Different Socio-Economic Strata in an Urban Area of Delhi.**

Supervisors: Dr. Neena Bhatia and G.S. Toteja

Th 25973

### Abstract

Optimal nutrition through appropriate child feeding practices during the first two years of life is crucial to achieve the full potential of a child. This was a community based cross-sectional study conducted on 439 mother child (6-23 months) dyads in *three income groups-urban slum, low income group (LIG) and middle income group (MIG)* in an urban area of Delhi. The primary objective of the study was to assess the complementary feeding practices in the three income groups and the factors associated with appropriate complementary feeding practices. The study also assessed the diet and nutrient intake of children. Anthropometric indices were compared with regard to complementary feeding practices. The study also explored the association between maternal and child dietary diversity. The study was carried out in an urban area of West Delhi District. The categorization of households into MIG, LIG and urban slum was done based on class and type of houses. A pre-designed and pre-tested interview schedule was used to collect socio demographic information. Complementary feeding practices were assessed using World Health Organization's (WHO) Infant and young child feeding (IYCF) indicators, 2008. Diet and nutrient intake of children was assessed using 24 hour dietary recall and a food frequency questionnaire (FFQ). Maternal dietary diversity was measured using the Minimum dietary diversity for women (MDD-W) tool by Food and Agriculture Organization (FAO) & United States Agency for International Development (USAID) Food and Nutrition Technical Assistance III Project, 2016. Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of Lady Irwin College, University of Delhi. SPSS software (version 21) software was used for statistical analysis of data. Majority of the population in all the three income groups consisted of Hindus, 76%, 88.7%, and 61.9 % in urban slum, LIG, and MIG respectively. The education status of mothers was better in MIG as compared to LIG and urban slum. MIG had higher percentage of children achieving minimum meal frequency (MMF), minimum dietary diversity (MDD), minimum acceptable diet (MAD) and the difference was statistically significant except for MDD (MMF: 22.0 %, 32.7 % and 44.6 % in urban slum, LIG and MIG respectively,  $p < 0.001$ ; MDD: 29.3 %, 31.3 % and 41.0 % in urban slum, LIG and MIG respectively; MAD: 8.0 %, 10.7 %, and 18.7 % in urban slum,



LIG and MIG respectively,  $p < 0.01$ ). It was found that 44.0 %, 42.0 %, and 41.7 % children had consumed sugary snacks in the urban slum, LIG and MIG respectively on the previous day of the survey. A little more than 50.0 % and about 22.0% children in all groups had consumed savoury snacks and sweetened beverages respectively on the previous day of the interview. No significant difference was found in the consumption of SSSBs in the three income groups. The factors across the three income groups that were significantly associated with achievement of MDD, MMF and MAD were, age of the child, mother's education and house hold income ( $p < 0.05$ ). The likelihood of a child achieving MDD, MMF and MAD were higher in children older than 12 months of age, those who belonged to households with higher monthly income and children belonging to mothers having education level higher than primary. For children 6-12 months, the adequacy of food intake was found to be lower than the recommended levels for all the food groups and nutrients in all the three groups, except for protein (the median percent adequacy was greater than 100% in LIG and MIG). For children 13-23 months, the adequacy of intake of all food groups was found to be poor in urban slum and LIG, it was relatively better in MIG, though still remained inadequate ( $< 100\%$ ). The median percent adequacy was more than 100 percent only for protein in the three groups. The median intake of all the nutrients (except energy and vitamin C) was found to be higher in MIG as compared to the other two groups. The median intake of energy was higher in LIG as compared to the other two groups. The difference in the nutrient intake of children was found to be statistically significant for energy, protein, magnesium, iron, zinc, thiamine, riboflavin, niacin, vitamin B6, folate and vitamin A in the three groups ( $p < 0.05$ ). The prevalence of stunting, underweight and wasting was highest in urban slum followed by LIG and MIG and the difference was statistically significant for stunting and underweight but not for wasting (*Stunting*: 23.4 %, 20.7 %, and 8.0% in urban slum, LIG and MIG respectively,  $p < 0.01$ ; *Underweight*: 32.2 %, 31.3% and 13.2% in urban slum, LIG and MIG respectively,  $p < 0.001$ ; *Wasting*: 24.8 %, 18.4 % and 13.8 % in urban slum, LIG and MIG respectively). Among children 6-12 months MDD and MMF were found to be significantly associated with underweight. When MDD and MFF were achieved, the odds of not being underweight were 2.80 (95% CI:1.02-7.61,  $p < 0.05$ ) and 2.56 (95% CI:1.08- 6.24,  $p < 0.05$ ) times higher. No statistically significant association was found between any of the complementary feeding practice indicator and anthropometric status of children 13-23 months of age. The mean maternal dietary diversity was highest in the MIG ( $4.5 \pm 0.84$ ), followed by urban slum ( $4.42 \pm 0.94$ ) and LIG ( $4.37 \pm 0.91$ ). Among children, the mean dietary diversity was highest in the MIG ( $3.07 \pm 1.15$ ), followed by LIG ( $2.86 \pm 1.12$ ) and urban slum ( $2.53 \pm 1.34$ ) and the difference was found to be statistically significant ( $p = 0.01$ ). Mothers who had achieved minimum dietary diversity was highest in MIG (6.0%), followed by LIG (43.3%) and urban slum (42.7%). Mother's and child's dietary diversity was associated and the association was found to be statistically significant ( $p < 0.001$ ). The odds of a child achieving MDD were 2.44 times higher (95% CI: 1.63- 3.65) if mothers had achieved MDD as compared to when mothers had not achieved MDD and it was statistically significant ( $p < 0.001$ ). Complementary feeding practices were better in MIG but remained suboptimal across all three groups. There is an urgent need for intensified focus on counselling on complementary feeding practices across different settings and income groups. Dietary intake is an immediate determinant of child undernutrition and deficiency of nutrients during the critical growth period i.e. 6-24 months of age can lead to undernutrition and micronutrient deficiencies. Consumption of sugary, savory snacks and sweetened beverages (SSSBs) among children 6-

23 months of age is a concern and demands attention, especially in settings experiencing dietary transition and double burden of malnutrition. Behaviour change communication (BCC) strategies aimed at improving child's dietary diversity should also focus on promoting maternal dietary diversity and encourage mothers to feed young children all family foods and not just a subset.

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13. RIAZ (Ghazala)  
**Phytochemical Investigation of Indian Roselle (HIBISCUSM SABDARIFFA L.) and its Use in Value Added Food Products.**  
 Supervisors: Dr. Rajni Chopra and Meenakshi Garg  
Th 25968

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