Chapter -III
Research methodology

The methodology of the present study has been divided into following part

1. Selection of area
   a. Demographic information
2. Research Design of questionnaire
3. Major factor involved in study
   a. General information
   b. Specific information
   c. Legal awareness
4. Tools and technique
   a. Sampling Procedure
   b. Data collection
   c. Master chart preparation
   d. Analysis of data
   e. Experience of data collections
5. Validation of survey by experiment in laboratory
6. Educational program in sampled area for

3.1 Selection of area

Populated urban area were randomly selected area studied were, Lanka, Nadesher Ordely Bazar and Sigra of Varanasi district.

3.1.1. Demography of district Varanasi

Varanasi also commonly known as Benares or Banaras (Hindi: बनारस, Urdu: بِنارس, and Kashi (Hindi: काशी, Urdu: کا شی, Kāśī), is a city situated on the (west) bank of the
River Ganga (Ganges) in the Indian state of Uttar Pradesh, regarded as holy by Hindus, Buddhists, and Jains. It is one of the oldest continually inhabited cities in the world. The population of Varanasi urban agglomeration in 2001 was 1,371,749; the sex ratio was 879 females every 1000 males. However, the area under Varanasi Nagar Nigam has a population of 1,100,748 with the sex ratio being 883 females for every 1000 males. The literacy rate in the urban agglomeration is 77% while that in the municipal corporation area is 78%. Approximately 138,000 people in the municipal area live in slums.

3.1.2. Location of the studied area:
The city of Varanasi is located in the middle Ganga valley of North India, in the Eastern part of the state of Uttar Pradesh, along the left crescent-shaped bank of the Ganga river. It has the headquarters of Varanasi district. The "Varanasi Urban Agglomeration" an agglomeration of seven urban sub-units covers an area of 112.26 km² (approximately 43 mi²). The urban agglomeration is stretched between 82° 56’E - 83° 03’E and 25° 14’N - 25° 23.5’N. Being located in the Indo-Gangetic Plains of North India, the land is very fertile because low level floods in the Ganges continually replenish the soil. On a local level, Varanasi is located on a higher ground between rivers Ganga and Varuna, the mean elevation being 80.71 m. (Atrip4india.com) As a result of absence of tributaries and canals, the main land is continuous and relatively dry.

For the present study populated urban area of Varanasi is proper place. City Varanasi is famous for their special life style and their soulful vision of spending life. For the study of food and food adulteration it’s a wonderful and challenging area for researchers. The specific locations of study have selected are: Orderly bazaar, Nadesher, Sigra, and Lanka. In the selected area respondent are randomly selected.

3.1.3. Climate of the studied area:
Varanasi has a humid subtropical climate with large variations between summer and winter temperatures. Summers are long, from early April to October, with intervening
monsoon seasons. Cold waves from the Himalayan region cause temperatures to dip across the city in the winter from December to February.

The temperature ranges between 32°C – 46°C (90°F – 115°F) in the summers, and 5°C – 15°C (41°F – 59°F) in the winters. The average annual rainfall is 1110 mm (44 in). Fog is common in the winters, while hot dry winds, called loo, blow in the summers.

3.1.4. Industrial importance of the studied area:
Varanasi has several small cottage industries, including Banarasi Silk sari making, the production of textiles such as hand-woven carpets, and handicrafts. Banarasi paan (betel leaf) and khoa (a milk product) are popular.

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3.1.5. Educational facilities of Varanasi:
Varanasi is the site of three public universities. Banaras Hindu University, which includes Institute of Technology and Institute of Medical Sciences, is among the top 3 largest residential universities in the world having more than 128 independent teaching departments. Mahatma Gandhi Kashi Vidyapeeth and Sampurnanand Sanskrit University are the other two universities. The Central Institute of Higher Tibetan Studies (Central University of Tibetan Studies) at Sarnath is a deemed university with a preference for the traditional Tibetan method of teaching within a framework of modern universities. Udai Pratap College, autonomous college, is the center of sports and science study for the suburban students of modern Benares.

Varanasi has many private and public institutes that provide Hindu religious teaching. Since ancient times people have been coming to Varanasi to learn philosophy,
Sanskrit, astrology, social science and religious teachings. In Indian tradition, Varanasi is often called "Sarva Vidya Ki Rajdhani" (capital of knowledge). The city also has the Jamiah Salafiah, a Salafi Islamic institution.

There are various degree colleges across the city like Agrsen kanya P. G. College, Harishchandra degree college, Arya mahila Degree college, School of management Sciences. The schools are affiliated with the Indian Certificate of Secondary Education (ICSE), the Central Board of Secondary Education (CBSE), or the U. P. Board. Under the 10±2 plan, after completing their secondary education, students typically enroll in a 2 year junior college (also known as a pre-university) or in schools with a higher secondary facility.

**Table 3.1 Summary of demography of Varanasi state**

<table>
<thead>
<tr>
<th>State</th>
<th>Uttar Pradesh</th>
</tr>
</thead>
<tbody>
<tr>
<td>District(s)</td>
<td>Varanasi</td>
</tr>
<tr>
<td>Coordinates</td>
<td>25.36° N 83.13° E</td>
</tr>
<tr>
<td>Area</td>
<td>1550 km²</td>
</tr>
<tr>
<td>Elevation</td>
<td>80.71 m</td>
</tr>
<tr>
<td>Time zone</td>
<td>IST (UTC+5:30)</td>
</tr>
<tr>
<td>Population (2001)</td>
<td>1,211,749</td>
</tr>
<tr>
<td>Languages Spoken</td>
<td>Hindi, Sanskrit and English</td>
</tr>
<tr>
<td>STD Code:</td>
<td>0542</td>
</tr>
<tr>
<td>Population:</td>
<td>About 14 lakh.</td>
</tr>
<tr>
<td>Postal</td>
<td>221 001</td>
</tr>
<tr>
<td>Telephone</td>
<td>0542</td>
</tr>
</tbody>
</table>

**3.2 Research design**

Survey method was used in the present study with a structured type questionnaire (by the schedule cum interview method) as the data-collecting instrument. A stratified sampling was done from May, 2007 to June 2008 on food safety knowledge and practice of urban
consumers in the Varanasi districts of Uttar Pradesh. Before finalizing the questionnaire, the questionnaire was pilot tested on 30 participants (10% of 300 respondents) and minor modifications were made to the questions. A pilot or preliminary samples are generally drawn from the population and the statistics computed from this sample are used in determination of the sample size.

The revised questionnaire was divided into following sections: Personal information of respondent’s, Specific knowledge of respondents about materials of different commodities, Knowledge of consumer rights regarding to food and adulteration. The sampling included 160 female and 140 male respondents. Respondents were basically from household related to kitchen activity.

The data obtained were feed in the master chart and then analysis was done with the help of Excel add-in statistic solver and XL stat 9.0. In the present study, percentage, mean SD, and chi square test have been used for making the decision about hypothesis and Pearson correlation has been used to determine the effect of factors like age and education on food adulteration practices. Various type of graph like pie, bar and cone, cylinder chart are used to display the result and finally validation of the result were done by the testing various food materials collected from three selected regions in the laboratory by physical and chemical method.

3.2.1 Designing of the schedule
The frame of schedule was made after suggestions from experts of the subject, from literature available on the subject, and from statistic experts to get the effective and useful data for the study. The schedule was finally checked and lineup by the research supervisor and researcher. The time of one schedule filling was minimum 50 minutes.

3.2.2. Experience during the survey
Conducting survey was a pretty challenging job, yet it was interesting and fruitful because researchers had an opportunity to meet people from different sections of society and learned best way of interaction to people. After interaction researchers was motivated
to do something fruitful for such people. Survey was challenging since people were less responsive initially, and they used to keep their door shut. After many attempts later on when they understand that we are not gov. employee that came to fill the register they paid full attention and were more cooperative. Other reason for not cooperating with me was usually in most of the family men were working and female were housewife and remains at home in the day, and due to fear of theft and robbery they just keep shut their door. Since there was no one with me that was known to them also, therefore this was another problem that researcher faced during the work. Another problem we faced about talking to women of the household that don’t open the door and were talking behind the door and without opening the door they were replying the questions.

The most comfortable day was Sundays and holidays when whole family was there to meet and understand, and then after women and other member used to recognized me and then work become easier and respondents answered with full confidence. Opposite to this school going and young respondents were more cooperative and not only they answered confidently they used to involve their friends and without any problem they came with me and helped in making people understand what we want and thus they made data collection easier. Graduate respondents were freely exchanging their views about their experience of food adulteration (with name of shop that usually sold adulterated food) and many people used to avoid buying from such shop. Some respondents made comment on bribed that food inspector used to take from such shops and thus no proper action were taken even after complaint of the people and food items were found adulterated. Even such shopkeepers are many (milk item) that made group and were not cooperating when government officials used to check their food items. Recently in news such incident came to knowledge that shopkeepers opposed strongly when gov. official raided their shop during festival seasons for checking food items. Respondents not only commented on adulteration of food items but also on sold of duplicate labeled food items and drugs freely in the market. Currently due to several incidence of food poisoning in the state, educated respondents use to check the expiry date of the food item before use.
Educated respondents were happier with program telecast on the doordarshan ‘Jago grahak jago’ about different laws, right and type of adulteration present in the food. They were not happy with private channels that freely advertize the different food commodities without any such program of awareness made for the people. Recently during telephonic conference journalist were eager to know the different test available to check the adulterants in different items at home. Even from that area respondents received many calls after the publication of article in ‘Amar Ujala’ about food adulteration.

One dramatic observation came to knowledge of the researcher that most of the respondents were eager to obtain the healthy and pure food items without any adulteration but due to unavailability of any accurate homely test method they even unable to identify the adulteration made by the brand companies or local product makers. Only way was the taste or smell to identify the adulterants.

Other major observation was the shift in the buying behavior of the respondents where they choose to buy the food products from private retail companies like ‘Vishal’. Respondent were confused about selection of food items and there was not one proved consensus about choice of shop or brands. They all one or other way faced the problem of adulterants even from the shop that are felt reliable. Therefore many women asked to researcher about the brand name for different food items that were safe to use. They were eager to know that what will be the result of such study in other word they were asking about the “Impact of the study on food adulteration in their area”. Would govt. take any action after exposure of such incidence or this is just another study to make a report.

### 3.3. Major factor involved in study

Based on literature survey, a list of relevant variables was prepared. A questionnaire was prepared to capture the relevant variables, which was initially pre-tested at urban area of Varanasi. The data collection were aimed to get following information/response

a. Food safety practices,

b. Food safety behaviors,
c. Food safety knowledge,
d. Food handling practices.
e. Legal awareness,
f. Adulterant present in different food article.

The respondents were consumer from various educational and economical status of the selected sub- areas of Varanasi. Respondent was responsible for their family, purchasing of food materials and there preparation at home. Basically three type of information was collected for the present study. Personal information, information based on specific knowledge, and about different commodities used by them frequently.

- **Personal information of respondents.**
In this part questions were related to respondent’s age, education, family structure (nuclear/joint), total family income, religion, per capita income, marital status (married/unmarried).

- **Specific knowledge of respondents about materials of different commodities**
In this part questions were related to purchasing behavior, knowledge of adulterants, identification knowledge of adulterants, and effect of adulterants on health. For buying practices tendency data were collected for food items selection from retailer, stockiest, local market, or from supermarket. In buying practices various factor such as type of packaging used, branded verses local were studied. While for kitchen practices application and use of available knowledge on water quality and their impact on health were studied.

- **Knowledge of consumer rights regarding to food and adulteration**
In this part questions were related to PFA act, consumer related programs, consumer forum, standardization of food materials, and consumer behavior.

### 3.4. Instrumentation
A statistical instrument is any process that aim at describing a phenomena by using any instrument or device, however the results may be used as a control tool. Examples of statistical instruments are questionnaire and surveys sampling.
3.4.1. Sampling Procedure

The sample for the study was selected from Varanasi district of Uttar Pradesh. Selective sampling was chosen after critical review of literature. Respondent were mostly from middle income group and lower and higher income group respondents were also involved in the study as active respondents. There were fifty four percent female and forty six percent male respondents involved in the present study.

3.4.2 Data Collection

When the sampling units are human beings, the main methods of collecting information are: Door to door (face-to-face) interviewing surveys, telephone surveys, direct observation. And via Internet

In the present study method of door to door was adopted by the researcher. In total 300 respondents 140 male and 160 female were involved. Age group selected for study were range from 16-25, 26-35, 36-45 46-55 and >56 including both M and F respondents while educational background were selected from illiterate to post- graduate. Each questionnaire took 50 min to administer. Data were collected on weekends and weekday afternoons when a member of the particular target group would most likely be at home. Answers were graded by giving the tick mark on schedule for the right answers.

On the basis of the response, the observed and expected frequency were calculated for chi-square value and on the basis of degree of freedom in row and column t 0.05 value was compared for decision of null hypothesis. Cronbach alpha coefficient of internal consistency was used to estimate the reliability of the questionnaire. Alpha coefficients of 0.76 are considered to be acceptable.

3.4.3 Data analysis

Final data was collected from 300 respondents in Varanasi, Uttar Pradesh. The data were then tabulated processed and analyzed by percentage descriptive statistics, and chi square test, The findings were analyzed with XLSTAT 9.0 software (XLSTAT Version 2009 Addinsoft USA 1995-2009).
Mean responses SD, and percentages of responses in each category were calculated and presented in a tabular form. Pearson chi square was used in the evaluation of the questions. Cronbach’s alpha was calculated to determine the reliability of the attributes and behaviors. Based on use of this method, the survey items were found to have reliability coefficients markedly exceeding the typically accepted level of 0.5 (Hair, Anderson, & Black, 1995).

3.4.4 Statistical methods

(A) Mean

The mean of a sample or a population is computed by adding all of the observations and dividing by the number of observations.

Population mean $\mu = \frac{\Sigma X}{N}$ OR Sample mean $x = \frac{\Sigma x}{n}$

Where, $\Sigma X$ is the sum of all the population observations, $N$ is the number of population observations, $\Sigma x$ is the sum of all the sample observations, and $n$ is the number of sample observations.

(B) The Standard Deviation

The standard deviation is the square root of the variance. This term was first used by Pearson, 1894 is a commonly-used measure of variation. The standard deviation of a population of values is computed as:

Thus, the standard deviation of a population is:

$$\sigma = \sqrt{\frac{\sigma^2}{N}} = \sqrt{\frac{\Sigma (X_i - \mu)^2}{N}}$$

Where $\sigma$ is the population standard deviation, $\sigma^2$ is the population variance, $\mu$ is the population mean, $X_i$ is the $i$th element from the population and $N$ is the number of elements in the population. And the standard deviation of a sample is:

$$s = \sqrt{\frac{s^2}{n-1}} = \sqrt{\frac{\Sigma (x_i - \bar{x})^2}{n-1}}$$

Where $s$ is the sample standard deviation, $s^2$ is the sample variance, $\bar{x}$ is the sample mean, $x_i$ is the $i$th element from the sample, and $n$ is the number of elements in the sample.
(C) Percentage:
Percentage was calculated by dividing obtained value by total no of respondent.
Percentage= \( \frac{\text{Number of specific observation}}{\text{Total observation}} \) x 100

(D) Variance

Variance (this term was first used by Fisher, 1918a) is computed as:
\[ \sigma^2 = \frac{(x_i - \mu)^2}{(N-1)} \]

Where
\( \mu \) - sample mean
\( N \) - sample size

or

\[
\text{Variance} = \left[ \frac{N \sum fX^2 - (\sum fX)^2}{N(N-1)} \right]
\]

F is the frequency of x class and N is the total no. of observation and rest has the usual meaning.

(E) The test of hypothesis:

One may utilize \( \chi^2 \) test for test of hypothesis.

\( H_0 \): Row and column are independent to each other

\( H_a \): Row and column are dependent on each other

If the observed \( \chi^2 \) is more than expected (either at 0.05 or 0.01), then there is enough evidence to reject the null hypothesis. Otherwise, there is no reason to reject the null hypothesis.

(F) Chi-square test

A chi-square test (also chi-squared or \( \chi^2 \) test) is any statistical hypothesis test in which the sampling distribution of the test statistic is a chi-square distribution when the null hypothesis is true, or any in which this is asymptotically true, meaning that the sampling distribution (if the null hypothesis is true) can be made to approximate a chi-square distribution as closely as desired by making the sample size large enough.

Pearson's chi-square test, also known as the chi-square goodness-of-fit test or
chi-square test for independence ($\chi^2$). **Pearson's chi-square ($\chi^2$) test** is the best-known of several chi-square tests – statistical procedures whose results are evaluated by reference to the chi-square distribution. Its properties were first investigated by Karl Pearson. In contexts where it is important to make a distinction between the test statistic and its distribution, names similar to **Pearson X-squared** test or statistic are used.

The value of the test-statistic is

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i},$$

Where, $X^2$ = the test statistic that asymptotically approaches a $\chi^2$ distribution.

$O_i$ = an observed frequency;

$E_i$ = an expected (theoretical) frequency, asserted by the null hypothesis;

$n$ = the number of possible outcomes of each event.

**(G) Probability**

Specifically, the p-level represents the probability of error that is involved in accepting our observed result as valid, that is, as "representative of the population." For example, a p-level of .05 (i.e., 1/20) indicates that there is a 5% probability that the relation between the variables found in our sample is a "fluke.

The chi-square statistic can then be used to calculate a p-value by comparing the value of the statistic to a chi-square distribution. **The number of degrees of freedom is equal to the number of cells $n$, minus the reduction in degrees of freedom, $p$.** (Fisher and Yates, 1963)

If the test statistic is greater than the upper critical value or less than the lower critical value, we reject the null hypothesis.

1. $P< 0.05$ NS Statistically significant
2. $P*< 0.05$ just significant
3. $P** < 0.025$ or $< 0.01$ moderately significant
4. $P*** < 0.001$ highly significant

**(H) Degree of freedom**

Number of free movement of statistic is known as degree of freedom. For different
purpose no. of degree of freedom varies. It is always less than one from number of observation.

DF = (n-1) where DF is the degree of freedom

DF for \( \chi^2 \) –test = (C-1)(R-1)

C=number of column

R = number of row

3.5 Validation of adulterants in Lab

Validation of presence of food adulterants in three selected area was done in laboratory of Dept. of Biotechnology, Agrasen K P. G. College Varanasi by using following method.

Table 3.1 test of adulteration in various food products

<table>
<thead>
<tr>
<th>SN</th>
<th>Food article</th>
<th>Adulteration</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vegetable oil</td>
<td>Castor oil</td>
<td>Took 1 ml. of oil in a clean dry test tube.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Added 10 ml. Of acidified petroleum ether.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Shaken it vigorously for 2 minutes. Then</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Added 1 drop of Ammonium Molybdate reagent. The formation of turbidity indicates presence of Castor oil in the sample.</td>
</tr>
<tr>
<td>2.</td>
<td>Ghee</td>
<td>Mashed Potato</td>
<td>Added 5 ml, conc. HNO(_3) to 5 ml. sample. It was shaken carefully and allowed to separate yellow, orange yellow, crimson colour in the lower acid layer indicates adulteration.</td>
</tr>
</tbody>
</table>
Sweet Potato, etc. and added a drop of iodine solution after cooling it. Blue colour indicates presence of Starch. Colour disappears on boiling & reappears on cooling.

|       | Vanaspati       | Took 5 ml. of the sample in a test tube in which 5 ml of Hydrochloric acid and 0.4 ml of 2% furfural solution or sugar crystals was added. Sample was agitated for 2 minutes with the help of glass stopper. Development of a pink or red colour indicates presence of Vanaspati in Ghee. |

3. **Pulses** Kesari dal(*Lathyrus sativus*) In small quantity of dal 50 ml of dil. HCl was added and it was kept on simmering water for about 15 minutes. The pink colour, developed indicates the presence of Kesari dal.

4. **Pulses** Metanil Yellow(dye) To a small quantity of dal 5 ml conc.HCl was added in a little amount of water. Immediate development of pink colour indicates the presence of metanil yellow and similar colour dyes.

5. **Coriander** Dung powder Sample was soaked in water. Dung floats and
<table>
<thead>
<tr>
<th>powder</th>
<th>thus can be easily detected by its foul smell.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common salt</td>
<td>To 5 ml of sample added a few drops of silver nitrate. White precipitate indicates adulteration.</td>
</tr>
<tr>
<td>Chilies</td>
<td>Brick powder grit, sand, dirt, filth, etc. Sample was poured in a beaker containing a mixture of chloroform and carbon tetrachloride. Brick powder and grit get settled at the bottom.</td>
</tr>
<tr>
<td>Turmeric</td>
<td>Metanil Yellow Few drops of conc. Hydrochloric acid (HCl) were added to the sample. Instant appearance of violet colour, which disappears on dilution with water, indicates pure turmeric. If colour persists Metanil yellow is present.</td>
</tr>
<tr>
<td>Asafoetida (Heeng)</td>
<td>Soap stone, other earthy matter A little quantity of powdered sample was mixed with water. Soap stone or other earthy matter gets settled at the bottom.</td>
</tr>
<tr>
<td>Rice</td>
<td>Physical test Mixing of old and rotten broken rice in good rice</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>Excessive sand &amp; dirt A little quantity of sample was mixed with about 10 ml. Of Carbon tetra chloride and allow to stand. Grit and sandy matter will</td>
</tr>
</tbody>
</table>
3.6 Educational program in Varanasi for food adulteration via print media

Knowledge of adulteration in various food samples
For awareness of food adulteration result obtained in laboratory were spread via publication in *Dainik AMAR UJALA*

20 Nov 2009