Effect of food safety knowledge among the skilled workers of food industries processing minor fruits or wild edible plants in Manipur towards food safety

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ABSTRACT

A survey work was conducted in three districts of Manipur namely Imphal East, Imphal West and Bishnupur in order to study the effect of food safety knowledge among the skilled workers of food industries, processing minor fruits or wild edible plants, towards food safety. Through this study, a total of six food industries were selected, purposive sampling were used for selecting state, district and industries. However, for selecting the respondents (100 nos.) random sampling were used. The personal variables were treated as independent variables and variables pertaining to knowledge were treated as dependent variables. The majority of skilled workers in the food industries of Manipur were found to be unaware of food safety practices. The main objectives of the study were to examine the respondents personal and socio-demographic profiles in order to assess their level of knowledge regarding food safety. From the research, it is revealed that 57% of the skilled workers had not visited any training institute and only formal training attended by them. The data pertaining to respondents visiting to training institution showed significant difference in knowledge level. ANOVA table revealed that residential area and caste of the respondents has significant differences in respondents' knowledge level. Knowledge on product safety and sanitisation basic concept regarding food safety was observed in our study while respondents have less knowledge about Hazard Analysis and Critical Control Points.

Keywords: Food handlers, food safety, HACCP, knowledge, respondent

INTRODUCTION

Food provides us with energy and makes it possible for us to live a decent life, but it can also cause health hazards that could cause illness or even death. Foods are an important source for achieving livelihood security (Rajasri, 2024).Food safety pertains how to handle, prepare and store food. Evaluating and enhancing the knowledge of food handlers on food safety has become a necessity and it is becoming a major factor in ensuring strict adherence to food safety standards. Every nation's foundation and most significant industry is the food sector

(Sadiku *et al.,* 2019). Any person who is directly involved in the production, preparation, or packaging of food commercially on food premises is referred to as a skilled food worker. Few studies have been conducted regarding the food safety knowledge among the skilled workers in food industries of Manipur. Skilled workers of food industries of Manipur were mostly unaware about the knowledge towards of food safety. An article study in Manipur by Devi and Somokanta (2016) and concluded that woman workers have less knowledge and least education so they are assigned with minimal tasks in food industries. Their study also found that male workers received managerial training as compare to females' workers. Evaluating the range of knowledge level among food industry workers can assist in identifying and comprehending the gaps in knowledge. Therefore, the current study is intended to find out the effect of knowledge about food safety among skilled workers in food industries processing minor fruits or wild edible plants of Manipur (India). The main objectives of the study were to examine the respondents personal and socio-demographic profiles and order to assess their level of knowledge regarding food safety.

MATERIALS AND METHODS

The present study was conducted from 2020 to 2022 in the Department of Pomology and Postharvest Technology, Faculty of Horticulture, Uttar Banga Krishi Vishwavidyalaya, Cooch Behar, West Bengal. However, the survey work was carried out in Manipur (India).

Research Design: Ex-post facto research is characterised as a systematic empirical investigation in which the independent variables are not directly under the researchers control since their manifestation has already occurred and they are not fundamentally manipulable. The present study was conducted in Manipur in three different districts namely Imphal East, Imphal West and Bishnupur which were selected as per the availability of food industries. The food industries which are selected were based upon the processing of minor fruits or wild edible plants available in the state of Manipur. Thanjam Agri Industry Pvt. Ltd., Taret foods Pvt. Ltd., Meira Foods Pvt. Ltd. were the food industries selected from Imphal East district. However, only one food industry i.e. Kangleipak Spice industry was selected from Imphal West district. Similarly, from Bishnupur district, only one food industry was selected namely Kangla Foods Products Pvt. Ltd. Since each food industry vary in the number of workers a greater number of respondents were from Thanjam Agri Industry Pvt. Ltd. which is twenty-five respondents each and twenty respondents from Taret foods Pvt. Ltd. However, a smaller number of respondents were selected from the remaining industries i.e. ten each from Meira Foods Pvt. Ltd., Kangleipak Spice industry and Kangla Foods Products Pvt. Ltd. Purposive sampling was used to select state, district as well as industry. Before the data collection, a pilot study was conducted in the selected area where personal interview was taken place. A pilot study is a small-scale exploratory study carried out before any large-scale quantitative research in order to assess the possibility for a future, full-scale project. Three districts were selected purposively for pilot study. Thus, a total of 100 numbers of respondents were selected randomly for the study.

Variables and their empirical measurements

Independent variables are the variables whose values don't depend on change in other variables and there are no other factors that influence independent variables. Variable that are unaffected by the other factors in this research are gender, marital status, religion, caste, family structure, residential area, level of education, use of internet to solve problems, visit to training institute. Total of 9 independent variables were selected for the present study. In case of Gender was coded as 1 for male, 2 for

female; Marital status was assigned scores based on categories such as 1 for married, 2 for unmarried and 3 for widowed and Religion which were categorized as Hindu (1), Muslims (2), Christian (3) and others (4) for the study. Level of education was recorded for every respondent and then classified into four categories namely illiterate, upto 10^{th} standard, 12^{th} standard and graduate. Score assigned are 0, 1, 2 and 3 respectively. Family structure/type was classified as nuclear and joint; visit to training institute was assigned as yes and no options and taking help from internet categorized as yes and no and score of 1 and 2 were assigned. Different caste enlisted for the present study are General, OBC, SC and ST respectively with score of 1, 2, 3 and 4.

The dependent variables, which are the respondents' knowledge of food safety, were assessed using a 23-questions survey designed to evaluate product safety, sanitationand HACCP knowledge. Three possible options for answering were provided in knowledge (correct, incorrect, don't know/can't remember). The responses to the questions were scored as follows: 2 points for a correct answer, 1 point for don't know/can't remember and 0 point for an incorrect answer.

Data collection: The study was conducted on the basis of survey method through scheduled questionnaire. The questionnaires used in the study were self-administered, standardized with slight modification, after thorough consultation with experts in this field. Knowledge of food safety in food industries product safety and sanitization and Hazard Analysis Critical Control Point references were from Jubayerer *et al.*,(2020). Information was collected from respondents using an interview scheduled designed to gather data on food safety, product safety, sanitization, and Hazard Analysis Critical Control Point practices.

Statistical analysis: The data from the study were processed using Microsoft Excel and analyzed with the support of SPSS statistical software. The statistical methods include percentage, using t-test and ANOVA were checked, including tests for normality and homogeneity of variances, where applicable as per the characteristics of data.

RESULTS AND DISCUSSION

Personal and socio-demographic profile of the respondent in our study revealed that (as shown in Table 1), most of the industrial workers were female (82%), followed by male (18%) belonging to Hindu (81%) community followed by Christian (12%). These workers were mostly unmarried (67%) and a few were married (33%) while half of the respondents belong to general category (52%) followed by OBC (38%), SC (5%) and ST (6%). Workers from nuclear family were 52% and the rest *i.e.*, 48% from joint family. However, the distribution of these industrial workers regarding to their residential area revealed that 38% were from village area followed by town (31%) and city (31%). These results were supported by Abdul-Mutalib *et al*., (2012); Alemayehu *et al.,* (2020) and Madhwal and Sharma (2019). Additionally, Ariyawansha *et. al*. (2024) from their study, also they concluded that female workers were 86% and male were 14%.

Based on their education level, the results show that the majority of industrial workers have studied up to the 10^{th} standard (48%), followed by 28% who are graduates, 22% who have completed the 12^{th} standard, and 2% who are illiterate. The findings were in close proximity with Madhwal and Sharma (2019) who reported that 46.7 % were graduates, 36% of the respondents were post graduates and 17.3% of the respondents covered upto 12^{th}standard.The distribution of respondents according to use of internet for solving their professional problems revealed that 67% of the respondent seeks the help of internet for seeking their professional problem while 33% of them doesn't use internet for any problem related to the profession. This concluded that more clearance of their doubt was by using

internet. Exposure of the respondents to various training programme were evaluated which revealed that 43% of the industry workers have visited training institute and 57% of them have not visit any training institute. This showed that respondents are more or less aware about the importance of training and the skills acquired through it. According to Malavi *et al.*(2021) their finding concluded that food safety training is an appropriate means for enhancing the knowledge and hygienic practices of food handlers.

Table 2 presents the t-test results for two qualitative categories of parameters in terms of knowledge. The data provide evidence that significant differences exist in the marital status of respondents, which correlates with their knowledge of food safety. Hence, the status of the respondents either married or unmarried has direct impact on the knowledge on food safety. On the other hand, there was also significant difference in visiting to training institute or by attending various training programme and this will enhance the knowledge level among the respondents in food safety. However, using internet to seek help regarding the profession/problem was found to be negatively significant which justified that using internet to solve the professional problem may not be the scientific approach to solve the problem as interest only gives a superficial idea hence the exact problem might have missed out. Apart from the parameters discussed above, other parameters showed non-significant differences among the variables.

Table 3 showed two categories qualitative parameters ANOVA in terms of knowledge which depict that residential area of the respondents has significant differences at 5% among the respondents. Similar results were observed in the respondents caste where a significant difference at 5% were found among the respondents belonging to different caste and also for where do they belong. However, no significant differences were found in between knowledge of the respondent towards food safety with level of education and religion they belong. The variables that depend on others in the study were categorized as knowledge level of the respondents which differs and depends on the respective respondents.

In aspects of the product safety and sanitization (Table 4), most responses were encountered in the questionnaire leaking package causes harm to the food product shelf life and occupied 1st rank scoring 197. The second highest-ranked response (score: 192) was related to the need to inspect all raw materials immediately upon arrival at the industry before storage. The above observations suggested that respondents are aware of shelf life and safety of raw materials in regards of product storage. For this most respondents answered correct option. Other statements that are due to poor temperature control bacteria can grow on stored product also scored 192 and was in 2ndrank. However, the last rank was obtained by questionnaire necessary temperature and relative humidity must be maintained at different production areas which scored 162 marks followed by the questionnaire traffic light labelling in colour codes indicate whether the amount recommended daily intake in the serving was low (Green), medium (Yellow) and high (Red) recorded 135 marks which secured last second position. The above least rank results indicated that respondents are having modest knowledge in view of food safety which is a drawback criterion in food industries. The current finding were in confirmation with Worsfold (1993) that employee education has been found to enhance sanitary awareness and knowledge of food safety issues, as well as perhaps enhance food safety procedures. Workers in most industries have been held liable for some occurrences of food safety issues like food borne diseases and illnesses due to improper management and handling of food (Greig *et al.,* 2007 and Ansari-Lari *et al.,* 2010). Improper management and handling of food is one of the main causes of food safety

issues. Another study by Ko (2013) suggested that crucial strategy for regulating microbial development in foods by temperature management. In the food sector, there is a strong need for digitization and automated operation of several industrial operations (Hassoun *et al.*,2023).

Among the HACCP-related knowledge questions in Table 5, the highest-ranked statement was that cleaning and disinfection are part of a prerequisite program. This was correctly acknowledged by 89 respondents, with a total score of 188. Among the remaining respondents, 10 answered 'Don't know' or 'Can't remember' and one responded incorrect. The above obtained results represented that respondents have good knowledge in terms of pre-requisite programs in food industries. Another statements *i.e.*, falsifying records was a criminal offense rank 2nd which was responded by 87 respondents scoring 187 in which no one has given an incorrect choice. Metal detection just before the packaging was a CCP (Critical Control Point) which scored 133 marks responded least by the respondents placing itself in the second last position. Second-last ranked statement was 'HACCP must be implemented in the plant to ensure food safety,' which scored 134 points. Respondents in food industries in Manipur have less knowledge in terms of Critical Control Points and HACCP which is an important step in preventing hazard in food industry. According to a study by Jubayer *et al.* (2020) in food industry, staff members had a thorough comprehension of food manufacturing process, employees were aware of the physical risks, the requirement for calibration, maintaining checklists, record keeping, cleanliness, and disinfection as a preparatory programme and some of the respondents were unaware that falsifying records is a crime and the HACCP system is poorly understood by the workers which was in line with our study. An assertion on cleaning disinfection as a prerequisite programme and remedial action in the work area of the study seem to be understood by all respondents. *Ocimum* species essential oil may be used in food industries to successfully manage phytopathogenic fungus (Guragai *et al.*, 2022). According to Walker *et al.* (2003) poor temperature comprehension may be a significant barrier to efficient HACCP implementation because temperature treatment is typically the crucial control point in a production process would be a justification with our findings where we have emphasized that HACCP must be implemented implant to ensure food safety. Additionally, industrial food safety training prioritizes hygiene over generic food safety knowledge as stated by Worsfold and Griffith, 2003. Another study by Mortimore and Wallace (2013) reported that falsifying record is a criminal offense is known to most of the respondents which supported our study as 87 respondents agreed. To ensure correct food handling and to set rules for food hygiene and safety, food safety culture is necessary as stated by de Andrade *et al.* (2020) and Nyarugwe *et al.*(2018). Jubayer *et al.*, (2020) pointed out that the respondents were satisfactory when dealt with product safety and hygiene. In our present study we also emphasize that the management should be strongly advised to provide ethical training for their staff regarding CCP and HACCP.

CONCLUSIONS

Food safety knowledge among skilled workers in the food industry is essential, as they are the ones ultimately handling products from raw materials to their final form. Thus, the personal and socio-demographic condition of the skilled workers of food industries will definitely have a direct impact on their knowledge and food safety. Most of the workers were female so male should be encouraged to work in food industry. These workers mainly belong to Hindu community under the general category of approximately 50% from nuclear family. The personal and socio-demographic factors of respondents had a significant impact on their food safety knowledge, as evidenced by their frequent use of the internet to address

work-related issues. Attending training institutes or participating in more training programs further enhanced their understanding of food safety. Thus, working experience of respondents could be increased and visiting to training institute could improve their knowledge on food safety. Knowledge of the respondents needs to be highlighted more regarding CCP of food products which can be acquired attending various training programme. However, quality standard before dispatch, storage of food, temperature monitoring, traffic light labelling in colour codes and implementation of HACCP was less in their knowledge of respondents regarding food safety. So, the managing team can conduct training and awareness program regarding food safety and the respondents themselves can learn from online source also.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: Personal and socio-demographic profile of the skilled workers

Sl.No.	Statements	Parameters	Percentage (%)
1.	Gender	Male	18
		Female	82
2.	Religion	Hindu	81
		Muslim	0
		Christian	7
		Others	12
3.	Marital status	Married	33
		Unmarried	67
		Widowed	0
4.	Caste	General	51
		OBC	38
		SC	5
		ST	6
5.	Family structure	Nuclear	52
		Joint	48
6.	Residential area	Village	38
		Town	31
		City	31
7.	Level of education	Illiterate	2
		Upto10^{th}	48
		12^{th}	22
		Graduate	28
8.	Help from Internet	Yes	67
		No	33
9.	Visit to any training institute	Yes	43
		No	57

Table 2: t-test for two categories qualitative parameters on knowledge of the skilled workers

Variables	Dependent (Variable knowledge)	Variables	Mean	t-value	Probability
Gender	Knowledge	Male	76.500	-1.953	0.054
		Female	80.148		
Marital status	Knowledge	Married	82.545	3.038*	0.003
		Unmarried	78.044		
Family Structure	Knowledge	Nuclear	80.470	1.407	0.163
		Joint	78.404		
Visit to training Institute	Knowledge	Yes	81.186	2.015*	0.047
		No	78.280		
Use of internet	Knowledge	Yes	78.209	-2.677*	0.009
		No	82.212		

*Significance Level: $p < 0.05$ indicates a statistically significant difference (2-tailed test)

Table 3: ANOVA for more than two categories qualitative parameters on knowledge of the skilled workers

Variables	Knowledge			
	Mean	**SD Error**	**F value**	**Probability**
Level of education				
Illiterate	77.500	5.132	0.910	0.439
$<10^{th}$	79.375	1.048		
12^{th}	81.591	1.547		
Graduate	78.321	1.372		
Residential area				
Village	76.289[b]	1.108	7.231	0.001*
Town	80.806[a]	1.227		
City	82.226[a]	1.227		
Caste				
General	80.039[a]	0.907	3.955	0.010*
OBC	80.789[a]	1.168		
SC	73.400[b]	2.675		
ST	72.333[b]	3.946		
Religion				
Hindu	79.962	0.774	2.02	0.138
Christian	74.285	3.455		
Others	79.666	2.133		

Significance Level: $p < 0.05$ indicates a statistically significant difference (2-tailed test)

Table 4: Distribution of skilled workers towards product safety and sanitisation in food industries (Total number of respondents=100)

Sl. No.	Questions	Correct (2)	Incorrect (0)	Don't know/ remember (1)	Total Weighted Score	Weighted Mean Score	Weighted Mean Rank
1.	Storing conditions of food can have possible effects on human health	90	1	9	189	1.89	III
2.	It was required to clean the food thermometers at a regular interval	86	0	14	186	1.86	V
3.	Environment pollution condition can affect the product	83	0	17	183	1.83	VII
4.	Necessary temperature and relative humidity must be maintained at different production areas	62	0	38	162	1.62	IX
5.	Raw materials should not be stored with finished goods	88	0	12	188	1.88	IV
6.	Leaking package causes harm to the food product shelf life	97	0	3	197	1.97	I
7.	When a shipment of raw materials arrives, it was required to inspect all right away before storing	93	1	6	192	1.92	II
8.	Before and after production, cleaning of processing area and equipment was a must to ensure food safety	85	0	15	185	1.85	VI
9.	Traffic light labelling in colour codes indicate whether the amount recommended daily intake in the serving was low (Green), medium (Yellow) and high (Red)	43	8	49	135	1.35	X
10.	Use Class II preservatives have maximum permissible limits of their use as per law	77	4	19	173	1.73	VIII
11.	Due to poor temperature control bacteria can grow on stored product	92	0	8	192	1.92	II

Table 5: Respondents Knowledge of HACCP (Hazard Analysis and Critical Control Points) Related to Product Safety and Sanitation in the Food Industry (Total number of respondents=100)

Sl. No.	Questions	Correct (2)	Incorrect Responses (0)	Don't know/ Can't Remember (1)	Total Score (Weighted)	Weighted Mean	Rank based on Weighted Mean
1.	Dirt, broken glass and staples from packaging are classified as physical hazards	90	6	4	184	1.84	III
2.	Metal detection just before the packaging was a CCP (Critical Control Point)	34	1	65	133	1.33	XI
3.	All checklists at every point of production floor must be updated at 30 min interval	74	2	24	172	1.72	VIII
4.	Falsifying records was a criminal offense	87	0	13	187	1.87	II
5.	The first line of defence was the workers in processing facility	84	6	10	178	1.78	VI
6.	Cleaning and disinfection was a type of pre-requisite program	89	1	10	188	1.88	I
7.	Calibration of equipment such as balances, measuring instruments, temperature meters etc./was compulsory in due time	75	1	24	174	1.74	VII
8.	Document the deviation was a step in the corrective action process	76	5	19	171	1.71	IX
9.	It was necessary to construct flowchart of individual processes and display it in relevant area	83	2	15	181	1.81	IV
10.	During record keeping, you should always sign and date as necessary	82	2	16	180	1.8	V
11.	Critical control point prevent the occurrence of food hazard	75	3	22	172	1.72	VIII
12.	HACCP must be implemented in plant to ensure food safety	40	6	54	134	1.34	X