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RESEARCH ARTICLE

Evaluation of knowledge, attitudes, and practices of estate managers on food safety of black tea manufacturing in the Uva region of Sri Lanka

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ABSTRACT

Sri Lankan black tea is renowned for its high quality and regarded as a brand that is chemically safe, ozone-friendly, and ethically acceptable with accountable stakeholders in the supply chain. Meantime, food safety has become one of the mandated food attributes that is heavily concern by stakeholders even at the estate level. Hence, this study aimed to determine the level of knowledge, attitudes, and practice (KAP) of managers at black tea manufacturing in the Uva region of Sri Lanka regarding basic food safety concerns. Data were collected from 30 respondents at 30 black tea manufacturing factories in the Uva region using a stratified random sampling technique. A pre-tested interviewer-administered questionnaire based on KAP of basic food safety was utilized and collected data were analyzed using descriptive analysis and correlation analysis. The study indicated that the mean percentage of knowledge was satisfactory (93.1%), and the mean score for attitudes and practices of food safety was 4.7±0.4 (X±SD) and 4.6±0.5 (X±SD), respectively. However, this study depicted that the knowledge of food safety influenced managers' attitudes (0.421, P<0.05) but not their food safety behaviour. Further, they believed that food safety management systems would be a means of directing their black tea to the international market (76.7%), while pledging the concerns of food safety (70%). However, it was depicted that constraints with food handlers (100%) and financial difficulties (73.3%) hugely affected the implementation of food safety management systems at the black tea manufacturing factories in the Uva region of Sri Lanka. Hence, this study suggests continuous, periodical but short training to sustain the practice of handling teas safely in the Uva region of Sri Lanka.

***Keywords**: Black tea manufacturing, Food safety, KAP model*

INTRODUCTION

The global agri-food trade has become an increasingly growing business encountered with ever-growing standards with different facets. Food safety scandals (Gereffi and Lee, 2009), adulterations and frauds (Handford *et al.*, 2016;

Swinnen, 2017) such malpractices along with other concerns have made consumers doubt the safety and quality of foods. Among all, tea is a globally demanding beverage and a vertically integrated industry. In the midst of other countries, Sri Lanka is the finest, but quality confined black tea supplier to the international market. Noticeably, "Ceylon Teas" accompanies the label of "Cleanest Tea" conforming to International Organization for Standardization (ISO) introduced maximum residue level (MRL) of pesticides. Nevertheless, this industry is increasingly subjected to many stringent standards with different disciplines (Wijayasiri, 2017), to ensure consumers' health, safety and many other concerns from raw materials to consumer goods (Wijayasiri and Jayaratne, 2011).

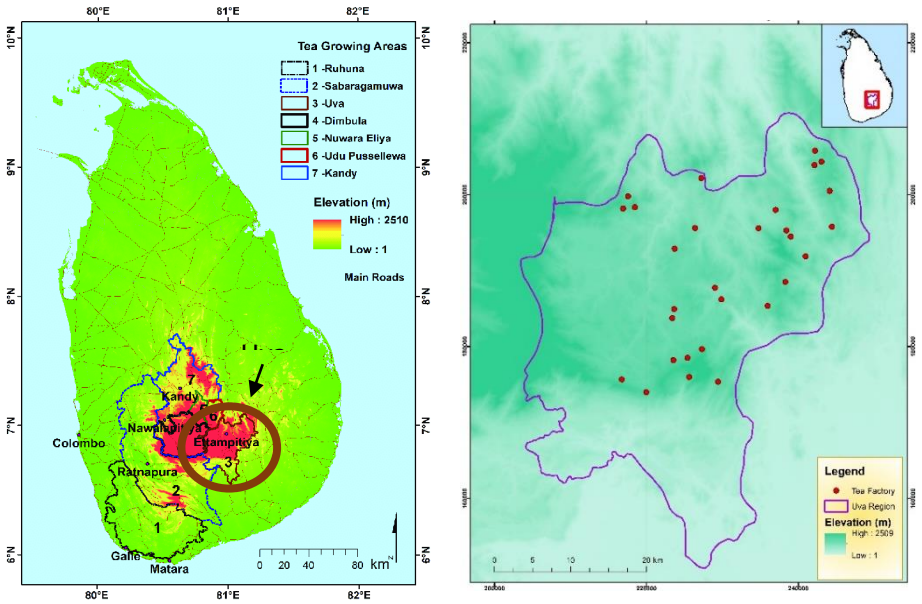
Hence, each stakeholder is accountable for performing different roles accordingly in assuring the quality, safety, and healthiness of tea products. For instance, food handlers' committed role in the prevention of foodborne diseases (Soon *et al.*, 2011) or reducing the effect of occurrences of foodborne illnesses because they can become a vector of transferring possible harmful microorganisms to cause foodborne illnesses (Abdul-Mutalib *et al.*, 2012). Though food handler has a deliberate enormous role in mitigating the effect of occurrences of foodborne illnesses, the manager is the accountable person for creating a "food safety culture" within the whole working environment (Al-Kandari *et al.*, 2019). Further, he facilitates and creates the food safety and hygiene-based code of practice, which leads to having a proper food handling environment (Jubayer *et al.*, 2020). Though managers adopt food safety-based practices, food handlers were found to be unsatisfactory in knowledge of food safety even though the factories were certified with ISO 22000 standards. It may be due to the limited, but fewer facilities provided for training programs (Lokunarangodage *et al.*, 2016). In fact, a lack of expert knowledge in food safety, unacceptable practices, and personal hygiene led to witnessing food safety desecrations during manufacturing (Galgamuwa *et al.*, 2016). Hence, the manager is accountable for striving to maintain both safety and quality attributes by adopting some concerned food safety management systems. Therefore, managers as the leading role personnel at the tea manufacturing factories, should be occupied with a sound knowledge food safety to meet the expected requirements. Accordingly, this study was determined to identify the knowledge, attitude, and practice (KAP) on food safety of managers in the plantations of the Uva region of Sri Lanka.

MATERIALS AND METHODS

Study area

The study was conducted from January, 2021 to April, 2021 among managers working at 30 black tea manufacturing factories located in the Uva region of Sri Lanka as illustrated in Figure 1. These tea factories are confined to tea-growing regions in the Uva provincial boundaries that as Uva high (above 1200 above

mean sea level [*amsl*]) and Uva medium (600 – 1200 *amsl*) as per the elevations. The time duration was inadvertently extended due to the imposition of government COVID-19 prevention protocols and restrictions imposed on unauthorized persons visiting the factories.



(a) **(b)**

Figure 1: (a) Major tea growing regions in Sri Lanka (b) Locations of the sample of tea factories in the Uva region

Study design

The research was conducted as a cross-sectional study among managers employed at black tea manufacturing factories in the Uva region of Sri Lanka. Thirty four black tea manufacturing factories out of 61, had given their permission to conduct an interview with their tea handlers. Accordingly, a stratified random sampling method was adopted to select tea handlers employed at 30 tea factories. This was done in proportionate to the actual number of factories located in each stratum of Uva high (above 1200 *amsl*) and Uva medium (600 – 1200 *amsl*) with a view to collect their feedback. Subsequently, managers (30) were selected as the sample using the stratified random sampling techniques.

Questionnaire design and data collection

A pre-tested, interviewer-administered, semi-structured questionnaire was used to collect data, which was modified slightly as per the requirements of food handlers in tea manufacturing. It included information related to; (i) socio-demographic and other characteristics of respondents; (ii) awareness of basic tea contaminating hazards, (iii) "Knowledge, Attitude and Practice" over basic food safety and hygienic practices required with Food Safety Management Systems (FSMS); (iv) association among KAP over food safety and hygiene; (v) benefits, constraints, and suggestions in adopting to implement FSMS.

The KAP model was used to assess knowledge, attitude and practices on food safety practices among managers. The knowledge of managers was assessed on basic food safety aspects using 14 statements. "True", "False" and "Do not know" options were provided to collect the responses for each statement of knowledge pertaining to basic food safety concerns. Moreover, their attitude toward food safety was measured with identified 15 statements with a scale from 5 = "Strongly agree" to 1= "Strongly disagree". Moreover, 19 statements were adopted and utilized for practices of food safety and measured using a scale of 5 = "always", 4 = "often", 3= "sometimes", 2 = "rarely" and 1= "never". These statements pertaining to knowledge, attitude and practices were extracted from previous related studies with modifications as per Sri Lankan black tea manufacturing. This questionnaire was originally prepared in English and was translated into Sinhala language to persuade the respondents. Prior to the main survey, a pilot survey was conducted to confirm the clarity of the questions and identify participants' opinions and time requirements. With the consent of participants and the approval of the respective tea factory, the questionnaire was filled out through face-to-face interviews. Data analysis was conducted as descriptive analysis, reliability analysis, and correlation analysis. The SPSS 16.0 statistical software and Excel Microsoft package were used for data tabulation and data analysis.

RESULTS AND DISCUSSION

Descriptive analysis of information on selected black tea manufacturing factories

Estate managers employed at black tea manufacturing factories in the Uva region were investigated on food safety concerns considered in black tea manufacturing. Further, the performance of sampled tea factories was summarized with respect to their production indicators. The basic information of randomly selected 30 black tea manufacturing factories and their production performances are summarized in Table 1.

Table 1: Basic information on the black tea manufacturing tea factories

Indicators	Mean	Standard deviation	Maximum	Minimum
Average made tea production per month (kg/month)	45,928.03	22,577.65	102,462.08	12,296.83
Average factory gross out-turn (GOT)	25.70	1.70	29.00	21.50
Average factory net out-turn (NOT)	22.76	1.09	25.00	20.50
Net sale average (NSA) (Rs.)	561.83	46.28	662.60	472.83

According to Table 1, the performance of the black tea manufacturing factories could be described in terms of their average made tea production per month, gross out-turn (GOT), net out-turn (NOT) and net sale average (NSA). Accordingly, average made tea production per month, average GOT, average NOT, and average NSA per factory within the selected sampled tea factories were observed as 45,928.03±22,577.65 kg/month, 25.70±1.70, 22.76±1.09, and Rs. 561.83±46.28, respectively.

The average "made tea" production per month was increased from 102,462.08 to 12,296.83 made tea kg/month with a mean of 45,928.03±22,577.65 made tea kg/month for the year 2020 within the sample. The GOT was defined as the quantity of fired teas that can be produced from a unit weight of green teas (Mohomed *et al.*, 2003). Accordingly, the average GOT per factory within the selected sample of tea factories was observed as 25.70±1.70 and it explained that 25.70 kg of fired teas can be produced from 100 kg green tea leaves with a standard deviation of 1.70 kg.

The average NOT is the percentage of graded tea that can be produced from 1 kg of green leaf (Mohomed *et al.*, 2003). However, the average NOT within the sample was observed as 22.76±1.09 with a range of 25.00 and 20.50. Accordingly, 22.76±1.09 kg of black tea was produced from 100 kg of green tea leaves. However, the fitted Figure for NOT was 21.5%, even though there were certain confusions overfitting an average net out-turn to factories (Gajanayake, 2007).

The average factory-wise NSA was Rs.561.83±46.28 and the lowest and highest factory-wise NSA was Rs.472.83 and Rs.662.60, respectively, within sample tea

factories. The NSA is an indicator that is about the sold price of one kilogram of made teas per month at the auction with respect to a particular factory (Gajanayake, 2007). However, if the factories achieve high NSA prices, then it will move forward to strengthen the financial performance of the factory. In fact, increasing the price of NSA with the factory's reputation could influence by the adoption of certain food safety, quality, or any other systems (Karunarathne *et al.*, 2014). However, food safety and quality management aspects were not directly explained on NSA, though up and mid-country-based tea manufacturing factories were said to be more quality-conscious than low-country (Edirisinghe and Gajanayake, 2005).

Further, the study exposed that the sampled factories were certified by ISO 22000, Hazard Analysis Critical Control Point (HACCP), Good Manufacturing Practices (GMP), ISO 9001, 5S, CQC-QMS, Rain Forest Alliances (RA), and Ethical Tea Partnership (ETP) standards with a percentage of 43.3, 20, 3.3, 6.6, 3.3, 3.3, 76.6, and 13.3, respectively. A high percentage of factories (76.6%) were certified with RA certifications as well as ISO 22000 Food safety management system (43.3%). However, these certifications represent different disciplines such as food safety, quality management, and sustainability along with many more standards; because the Sri Lankan tea industry encountered new, stringent sanitary and other standards set by the importing countries (Lei, 2017). In fact, the adoption of GMP, Good Hygienic Practices (GHP), and Standard Sanitary Operations standards has become an essential requirement. However, compliance with HACCP or ISO 22000 standards had not still decreed as a mandated requirement (Wijayasiri *et al.*, 2018). Meantime, ISO 22000 was identified as the most acquired industrial international standard pertaining to food quality and safety of tea.

Descriptive analysis of sociodemographic characteristics

Socio-demographic characteristics of estate managers on gender, age, ethnicity, religion, education, monthly income, experience in the tea industry, attendance to food safety awareness sessions, and a number of food safety awareness sessions attended throughout plantation career are summarized in Table 2.

Table 2: Demographic and socio-economic characteristics of estate managers

Characteristics	Items	%
Gender	Male	100
	Female	-
Age (41.4±10.4 years)		
	≤ 20	-
	21-30	6.7
	31-40	50
	41-50	30
	> 51	13.3
Marital Status		
	Unmarried	3.3
	Married	96.7
Ethnicity		
	Sinhala	86.7
	Sri Lankan Tamil	6.7
	Indian Tamil	-
	Muslim	-
	Other	6.7
Religion		
	Buddhist	76.7
	Hinduism	6.6
	Islamic	-
	Christianity	16.7
	Other	-
Education (13.4±0.91 years)		
	Ordinary level	-
	Advanced level	80
	Diploma	13.3
	Degree level	3.3
	Master level	3.3
	Other	-

Monthly income		
	≤ Rs.40,000	-
	Rs.40,001-80,000	16.7
	Rs.80,001-120,000	30
	> Rs.120,000	53.3
Experience in tea industry (19.58±11.58 years)		
	≤ 10 years	13.3
	11-20 years	50
	21-30 years	27.7
	31-40 years	6.7
	> 40 years	3.3
Attendance to food safety awareness session		
	Attendees	93.3
	Non-attendees	6.7
Number of food safety sessions attended throughout the career		
	≤ 10	57.1
	11-20	21.4
	21-30	14.2
	> 30	7.1

% = Percentage of respondents, n=30

According to Table 2, almost all the respondents of estate managers were males (100%), with an average age of 41.4 ± 10.4 years. Even though their ages were ranged between 27 and 82 years, 50% of respondents were between the 31-40 age range. Most of the estate managers were married (96.7%) and the majority of them were Sinhala (86.7%) by ethnicity and Buddhists (76.7%) by religion. Among these managerial respondents, most of them had their formal education up to the Advanced level (80%) and considerably least number of them (6.6%) had postgraduate qualifications. Further, the majority of estate managers (53.3%) enjoyed a monthly income of more than Rs. 120,000.00. The average working experience of respondents was between 10 to 40 years. However, the majority (50%) of them had 11-20 years of experience in the tea industry. Further, it was found that even though there were managers who had not attended any food safety-related awareness programmes, the majority of them (93.3%) at least had

attended any food safety-related awareness programmes. However, among these attendees, about 57% of managers had undergone less than 10 food safety awareness sessions from the beginning to the date of their careers. Nevertheless, the majority of respondents were Sinhala-Buddhists with formal education up to Advanced Level, as well as most of them are young and in the middle age category. Further, their experience at estate factories was satisfactory, even though there were very few who did not attend any food safety awareness sessions. However, the majority of them in managerial positions have undergone a fair number of food safety awareness sessions.

Awareness of hazards contaminating tea

This part of the study was focused on the awareness of potential hazards contaminating black tea during black tea manufacturing among estate managers. All 30 estate managers were well aware that tea could be contaminated with hazards pertaining to biological, physical and chemical contaminants during the manufacturing process. In fact, all managers were aware that viruses, bacteria, and fungi can all cause foodborne diseases. Further, 3.3% of managers were aware that there are other organisms that can cause food-borne diseases as well. However, respondents were found to be known/heard of *Escherichia coli* (96.7%), *Salmonella* (93.3%), *Staphylococcus aureus* (56.7%), *Streptococcus* spp. (33.3%), *Bacillus cereus* (16.7%) and other pathogens (3.3%), respectively. Most of the estate managers knew that *E. coli* and *Salmonella*, *S. aureus* as pathogens responsible for contaminating teas. It might be due to Sri Lankan tea manufacturers being strictly asked to adhere to SLTB standards/guidelines. Few of the respondents had heard about *S. aureus*, *Streptococcus*, *B. cereus* and other pathogens. Even in export markets, there were cases with bacterial and mycotoxin issues including teas in the herbal and spices category (Lei, 2018), the presence of Khapra beetle (*Trogoderma granarium*) in the packaging of a Russian tea consignment (Ahlam, 2014). Hence, a lack of expert knowledge in food safety, unacceptable practices, and personal hygiene might be the reasons to witness food safety issues during black tea manufacturing (Galgamuwa *et al*., 2016). Moreover, being a crucial factor knowing about pathogenic microorganisms is a critical obligation to be aware for managers to satisfy the requirements of producing safe quality black teas. Hence, it was vital that the management of the factory as a decisive party to be aware of any potential risks that could contaminate teas at any stage of the production of black tea.

Basic knowledge, attitude, and practices on food safety of managers

Knowledge, attitude, and practice on basic food safety and hygienic practices pertaining to FSMS among estate managers were considered and summarized. KAP was assessed referring to previous studies on food safety and hygienic practices and modified as per-requisites of black tea manufacturing in Sri Lanka.

Knowledge on food safety during black tea manufacturing

The knowledge on food safety and hygienic practices among estate managers at black tea manufacturing factories in the Uva region of Sri Lanka was assessed in terms of; (i) personal hygiene, (ii) handling of tea, (iii) aspects of contamination, and (iv) cleaning procedure of tea during black tea manufacturing process and the outcomes are given in Table 3.

Managers' knowledge was assessed using 14 statements giving true, false, and do not know options. Accordingly, the average percentage of correct answers out of 14 statements given by a manager was 93.1%. "Hand hygiene can be kept by sufficient washing under running water and drying in preventing from bacterial contaminations" (K1) and "bare hands contacting with teas prevent contamination of food safety concerns" (K4) were shown as incorrect statements. These two statements were correctly answered by 70.0 and 26.6% of managers, respectively. Meanwhile, all managers correctly retorted other statements.

Hand hygiene is a prime concern since food handlers' hands act as a main source of contamination (Dharmarathne *et al.*, 2018). Hence, hand washing and keeping the hygiene of hands become a prime practice. However, even though, all respondents (100%) were aware that "proper hand washing reduces the risks of contamination of tea" (K9), 70.0% of respondents believed that "washing hands under running water and drying is sufficient enough to eliminate bacteria in keeping hand hygiene" (K1), which was considered as an incorrect answer (Woh *et al.*, 2016). Because, it is stated that proper handwashing follows sequential steps such as "wetting hands with running warm water using soap, washing with running warm water and wiping hands for dry" (Moreb *et al.*, 2017); "washing hands using lukewarm water, meticulous hand rubbing with soap for approximately 30 to 40 s, hand rinsing under running water, and hand drying with a disposable paper towel" (Oliveira *et al.*, 2021). Also, Amegah *et al.* (2020), stated that "wetting hands with clean running water, followed by the vigorous rubbing of lathered hands together for at least 20 sec, rinsing them under clean running water and drying the washed hands with a clean tissue, towel or air drier" are very important practices in keeping hand hygiene.

Table 3: Responses of estate mangers on knowledge of food safety (n=30)

	Statements	True (%)	False (%)	Do not know (%)
K1	Hand hygiene can be kept by sufficient washing under running water and drying in preventing from bacterial contaminations	30.0	70.0	0
K2	Wearing cap, gloves, masks, and adequate clothing can reduce the risk of contamination of teas	100	0	0
K3	Exposing or touching hair can cause to increase the food safety issues	100	0	0
K4	Bare hands contacting with teas prevent contamination of food safety concerns	73.3	26.6	0
K5	Contamination can be occurred when raw tea and finished tea products are kept together	100	0	0
K6	Keeping fingernails short and clean is important to avoid the contaminate from foodborne pathogens	100	0	0
K7	Infected cuts should be covered and avoid touching teas affect food safety	100	0	0
K8	Food handlers with diseases flu, vomiting, sneezing and other can be stance a risk of food contamination	100	0	0
K9	Washing hands properly reduce risks of contamination on teas	100	0	0
K10	Incorrect cleaning and sanitation procedures of equipment, machineries and work floor before starting and after finishing the manufacturing increase the risk of food borne diseases to consumers	100	0	0
K11	Black teas at the drier mouth must keep moisture below 3% in order to avoid contaminations of pathogenic microorganisms	100	0	0
K12	Winnowing of black teas reduce the prescence of physical hazards in teas specially heavy unnecessary particles	100	0	0
K13	Correct packing less than 5% moisture level and inspection of blended black teas are required to avoid the presence of physical hazards and contamination from pathogens	100	0	0
K14	Improper storing of teas at the factory can cause healthy issues to consumers	100	0	0

% = Percentage of respondents, n=30

In fact, washing hands with running water and drying were accepted as not sufficient to remove bacteria from hands (who *et al*., 2016). Further, handwashing with non-antibacterial soap was considered more effective in removing bacteria from hands than handwashing with water only (Burton *et al.*, 2011). However, hand sanitiser was explained as not much critical in food handling, while handwashing with lukewarm water and liquid soap could lead to an acceptable level of hand hygiene (Valero *et al*., 2016). As the management, respondents had general knowledge of hand washing. Because it was helping to reduce the contamination of teas. Nevertheless, they were not aware of the necessity of soap or detergent in removing bacteria from hands to reach an acceptable level.

Even though, all managers were aware of the fact that wearing protective gloves leads to prevention of contamination, 26.6% of respondents agreed with the statement stated that "bare hands contact with teas prevent contamination of food safety concerns" (K4); because if their bare hands were contaminated, there was a potential possibility to transmit foodborne diseases. According to FDA, bare hands should be avoided in touching with ready-to-eat (RTE) foods, while minimizing bare hand contact with other exposed foods (FDA, 2020). However, food handlers who were not wearing gloves during food handling; it could eventually increase the risk of food poisoning (Lee *et al*., 2017). Hence, there is a food safety concern when touching teas with bare hands, if they are not well cleaned and in the form of hygiene.

However, managers' knowledge of basic food safety and hygiene pertaining to FSMS was performed according to the arbitrary scale "Good", "Moderate", and "Poor" with slight modifications of terms developed by Pacholewicz *et al*. (2016) and Nyarugwe *et al*. (2018). Accordingly, all managers employed at sampled black tea manufacturing factories in the Uva region are "Good" in knowledge (13.03±0.93) pertaining to basic food safety and hygiene. Even though, "Good" in knowledge could be depicted as satisfactory, knowledge may not always prefer to be transformed into practice and attitudes in all forms as per Pacholewicz *et al*. (2016). In some studies, it had stated that in fact, knowledge might not be able to convert into the expected safety assurance behaviour within the factory on all occasions (Nyarugwe *et al*., 2018) such that might be an optimistic bias (Da Cunha *et al*., 2014).

Attitude on food safety during black tea manufacturing

Managers at the black tea factories in the Uva region were evaluated regarding their attitude on food safety during black tea manufacturing using 15 statements and results are shown in Table 4. The reliability test of knowledge among managers showed 0.7 as Cronbach's alpha coefficient. If Cronbach's alpha coefficient is equal to 0.7, then the internal consistency of these 15 items could be accepted (Pacholewicz *et al*., 2016). Hence, the statements demonstrated the attitude toward basic food safety and hygiene among managers in the questionnaire could be acceptable.

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Table 4: Responses of estate mangers on attitudes on food safety (n=30)

	Statements	Strongly agree (%)	Agree (%)	Uncertain (%)	Disagree (%)	Strongly disagree (%)	Mean ± SD
A1	Safe handling of tea during processing is an important job responsibility	96.6	3.4	0	0	0	4.97±0.18
A2	Learning more on food safety is important to me as a representative of the management	83.3	16.7	0	0	0	4.83±0.37
A3	Believe the way of handling tea relates to food safety in producing a quality teas	76.6	23.4	0	0	0	4.77±0.43
A4	Raw tea leaves should be kept separately from oxidized and dried teas	33.3	66.7	0	0	0	4.33±0.47
A5	Hand washing is a prime activity prior to handle teas in reducing risk of contamination	86.6	13.4	0	0	0	4.87±0.34
A6	Food handlers wearing caps for hairs, masks for aerosol droplets from sneezing and coughing, protective gloves and adequate clean clothing for dirt can reduce the risk of contamination of teas	90.0	10.0	0	0	0	4.90±0.30
A7	Altering food handling practices, when knowing they are incorrect in doing so	56.6	43.4	0	0	0	4.57±0.50
A8	Tea shouldn't be touched with wounded hands	80.0	20.0	0	0	0	4.80±0.40
A9	All food handlers should be medically examined annually and healthy to work	70.0	30.0	0	0	0	4.70±0.46
A10	Food handlers can be a source of foodborne outbreaks	43.3	56.7	0	0	0	4.43±0.00
A11	It is necessary to emphasize employees on cleaning work related machineries appropriately	43.3	56.7	0	0	0	4.43±0.50
A12	Attending training programme on food safety and hygienic produce safety tea production	53.3	46.7	0	0	0	4.50±0.57
A13	Monitoring drier temperatures and keeping moisture below 3% at the drier mouth are important in reducing risk of potential occurrences of microbial contamination	90.0	10.0	0	0	0	4.90±0.30
A14	Winnower operations and their control measures are important in reducing risk with heavy particles with possible contamination	83.3	16.7	0	0	0	4.83±0.37
A15	Inspection of packing of tea bags are important for reducing risk of possible contamination	90.0	10.0	0	0	0	4.90±0.30

% = Percentage of respondent

As per Table 4, all respondents agreed on each statement of attitude with a total mean score and average percentages for attitudes of 4.7±0.4 (5-Point Likert Scale) and 94.3%, respectively. The statement of attitude with the highest mean score (4.97 ± 0.18) was recorded for "safe handling of tea as an important responsibility" (A1). It implied that the majority of managers highly agreed and considered the safe handling of tea as an important responsibility of their own. Meantime, the lowest mean score recorded for the "raw tea leaves should be kept separately from oxidized and dried teas" (A4) was 4.33 ± 0.47. Even though, more than 90% of respondents strongly agreed on "safe handling of tea as an important responsibility" (A1), 76.6% of respondents strongly agreed the "way of handling tea relates to food safety in producing quality teas" (A3) (4.77±0.43). Further, the majority of respondents (83.3%) had strongly agreed on "learning more about food safety is important as to represent the management" (A2) (4.83±0.37). However, their view on "attending training programme on food safety and hygiene to produce safety assured tea production" (A12) was comparatively less (4.50±0.57). In fact, 56.6% of managers strongly believed that they have the attitude of "alter the practices if those practices were wrongly performed at the tea manufacturing" (A7). It could be any practice performed at the factory such as handwashing, foot bathing, handling teas etc. In considering the aspect of personal hygiene, 86.6% of respondents strongly agreed that "hand washing before handling teas is a prime activity in reducing the risk of contamination" (A5) (4.87±0.34). Similarly, 90% of respondents strongly believed that "wearing caps for hairs, masks for preventing aerosol droplets from sneezing and coughing, protective gloves and adequate clean clothing for dirt can reduce the risk of contamination of teas" (A6) (4.80±0.40). In fact, the majority (80%) of respondents strongly acclaimed that "tea shouldn't be touched with wounded hands" (A8) (4.90±0.30), while 70% of respondents strongly believed that "All food handlers should be medically examined regularly and to be healthy to work" (A9) (4.70±0.46). Comparatively, there were 43.3% of respondents strongly believed that "food handlers can be a cross-contamination source of foodborne outbreaks" (A10). In fact, 43.3% of managers believe the necessity to emphasize employees on cleaning work-related machineries appropriately (4.43±0.50). However, 70% of managers strongly emphasized the importance of attending medical examinations regularly, even 43.3% number of respondents strongly agreed that food handlers becoming a source of food outbreaks. The mean scores for the statements, "monitoring the temperature and keeping moisture below 3% at the drier mouth are important in reducing the risk of potential occurrences of microbial contamination" (A13), and "winnower operations and their control measures are important in reducing risk with heavy particles with possible contamination" (A14) and "inspection of packing of tea

bags are important for reducing the risk of possible contamination" (A15) were respectively exhibited an average score of 4.90±0.30, 4.83±0.37 and 4.90±0.30 (5 Point-Likert Scale). However, respondents strongly agreed about these aforesaid three areas in terms of contaminating black teas as a percentage of 90, 83.3 and 90 respectively, though they could vary from factory to factory based on their situational practices.

Managers at any food service centre, restaurant or food handling centre a decision-makers among many other roles even considering food safety (Gruenfeldova *et al.*, 2019). Hence, their attitude is a crucial factor leading towards food safety stimulated practice or behaviour to reduce the occurrence of food-borne diseases with other potential hazards (Al-Shahib *et al.*, 2016) as food safety is unexplainable in creating a food safety culture within the factory. Accordingly, even estate managers at black tea manufacturing factories unanimously become decision-makers when handling teas at the factory. Further, managers also highly considered that safe food handling was an essential and required responsibility in producing safe quality black teas at factories in the Uva region. In fact, in some previous studies even, the majority of food handlers considered that safe food handling is a responsible part of their jobs to avoid food contamination and diseases (Mcintyre *et al.*, 2013; Al-shahib *et al.*, 2016), even though they were trained or non-trained food handlers (Mcintyre *et al.*, 2013). Even in this study, all respondents consider learning as a responsibility for accomplishing both roles of manager as well as food handler. Similarly, learning about food safety and quality management were considered as responsibilities that are more vital even when trained food handlers agreed 100% with non-trained agree by 54.5% (Jubayer *et al.*, 2020). However, in some studies, it exhibited that knowledge gained with experience had no relation with training with attitude (Al-Shahib *et al.*, 2016). Personal hygiene of food handlers was considered as a mandate apprehension in assuring safe foods (Jianu and Chiş, 2012). Wearing protective attires and other necessities was imperative in assuring safe foods, which was agreed upon by all respondents in this current study. Similarly, in some previous studies, all trained food handlers (100%) agreed that wearing caps, masks, and gloves was one of many responsibilities that contributed to assuring food safety, while 92.7% of untrained food handlers scepticism over the issues as not sure (Jubayer *et al.*, 2020). In fact, it is believed that food handlers with bruises, injuries or wounds should not touch foods (Da Cunha *et al.*, 2014; Al-Shahib *et al.*, 2016), while health checkups and health condition of food handlers were considerately concerned (Jubayer *et al.*, 2020).

In black tea manufacturing, moisture content at the drier mouth becomes a critical control point (CCP) for microbial hazards. Hence, the moisture content is required to be maintained below 3%. Further, monitoring the consistency of the appropriate temperature at the drier is important to dehydrate teas to inactivate microorganisms in black teas. Even studies on Up-country black tea manufacturing have explained that drier mouth becomes a CCP in terms of biological hazards due to moisture even though it was not properly validated (Bandara *et al.*, 2006). Further, Sorting, and grading in packing processed tea with storing were identified as CCPs in terms of microbiological hazards (Pathirana, 2005), while moisture percentage was maintained below 4% (Bandara *et al.*, 2006).

Evaluate the practice of food safety and hygiene during black tea manufacturing of managers

Managers working at the black tea factories in the Uva region were evaluated using 19 statements and results are shown in Table 5. The reliability test showed 0.8 as the Cronbach's alpha coefficient, which is greater than 0.7 (Pacholewicz *et al.*, 2016; Taber, 2018). Hence, the internal consistency of the 19 items indicating the knowledge among managers on the basics of food safety and hygiene was consistent with the questionnaire.

As per Table 5, the overall average score with a standard deviation and average percentages for practices were 4.6±0.5 and 92.8%, respectively. Further, all respondents had revealed that "if a manager was fallen into sick, or with wounds or injuries, they always would not handle teas at the factories" (P19). Meanwhile, the least practice always followed by respondents (23.3%) was the "wearing of hair protection cover appropriately when entering to the factory" (P9). However, managers "change their shoes when entering the factory" (P13) intermittently or rarely with 20% and 6.7%.

Hand hygiene is one of the main concerns in managing food hygiene. The majority of (63.3%) respondents were always "wash their hands with a detergent and running water" (P1). Even the majority of them practice "washing their hands before drinking tea" (P3), "after eating food" (P4) and "after each break time" (P5) with respect to 80%, 80% and 80% respectively. Even though, managers "wash their hands before engaging with teas, washing with sequential steps of drying hands using single-use towel" (P6) was practiced by 56.7% of respondents.

Table 5: Responses on food safety and hygiene practices of managers (n=30)

		Always (%)	Often (%)	Sometimes (%)	Rarely (%)	Never (%)	Mean ± SD
P1	Washing hands with soap (detergent) and running water	63.3	36.7	0	0	0	4.63±0.49
P2	Washing hands before engaging with tea	83.3	16.7	0	0	0	4.83±0.38
P3	Washing hands before eating foods	80.0	20.0	0	0	0	4.80±0.41
P4	Washing hands after eating foods	80.0	20.0	0	0	0	4.80±0.41
P5	Washing hands after each break time	80.0	20.0	0	0	0	4.80±0.41
P6	Contacting teas directly unless wash hands with running water and drying with single use towel/tissue/drier	56.7	43.3	0	0	0	4.57±0.5
P7	Wearing proper apron when handling with tea	46.7	53.3	0	0	0	4.47±0.51
P8	Keeping clean and short fingernails in handling teas	46.7	53.3	0	0	0	4.47±0.51
P9	Wearing a hair protection to cover all hairs, when I enter the factory	23.3	63.3	13.3	0	0	4.10±0.61
P10	Avoiding all adornments during the working hours	40.0	60.0	0	0	0	4.40±0.5
P11	Wearing facemask to avoid contaminations from sneezing, coughing etc.	80.0	13.3	6.7	0	0	4.73±0.58
P12	Bathing/Dipping foot at the entrance of the factory	73.3	23.3	3.3	0	0	4.70±0.53
P13	Changing shoes when entering to the factory	26.7	46.6	20.0	6.7	0	3.93±0.86
P14	Avoiding to practice forbidden activities	80.0	20.0	0	0	0	4.80±0.41
P15	Practicing proper practices after using bathrooms/rest rooms	80.0	20.0	0	0	0	4.80±0.41
P16	Advising employees to follow personal hygienic practices as per the standards requirements	73.3	26.7	0	0	0	4.73±0.45
P17	Advising employees on personal hygienic practices on producing quality teas as per the standards at the factories	80.0	20.0	0	0	0	4.80±0.41
P18	Monitoring employees on adapting proper personal hygienic practices within the factory to ensure the end tea products' safety and quality	77.7	23.3	0	0	0	4.77±0.43
P19	Avoid entering to factory during any sickness, with wounds or injuries	100	0	0	0	0	5.00±0.00

% = percentage of respondents

Except for hand hygiene, the majority of respondents often "practice wearing an apron" (P7), "excluding all possible adornments" (P10) and "keeping short and clean fingernails" (P8) with a percentage of 56.7, 53.3, 63.3, and 60.0, respectively. However, 80% of respondents always wore facemasks even though 2% of respondents wore facemasks intermittently (P11). Further, 63.3% of respondents often wore "hair protection when entering the factory" (P9), and 6.7% of respondents wore it occasionally. Moreover, the majority of 73.3% of respondents always "bath/dip their feet at the entrance of the factory" (P12), even though the majority of 46.6% of respondents always change their shoes before entering the factory as a regular practice.

The majority of (80%) respondents "avoid practicing forbidden activities (chewing, smoking, drinking, eating within the factory)" (P14), while following "proper practices after utilizing bathrooms or restrooms" (P15). Moreover, as a manager, the majority of respondents (73.3 and 80.0%) always "advice to follow personal hygienic practices as per the standards" (P16) and "advice on personal hygienic practices on producing quality teas" (P17), respectively. Even "monitoring food handlers adapting to proper hygienic practices" (P18) with 77.7%.

Hand hygienic practices are more vital in producing safe foods for end consumers since hands are more vulnerable to becoming sources of infections with potential pathogens, particularly during adverse environmental conditions. "Rinsing hands with soap and water before handling food, before/after eating, after going to the toilet, after handling raw food, after handling garbage/waste, after sneezing, after handling money, after touching animals and after touching body parts" were some of the critical incidents (Amegah *et al.*, 2020). In this study, the majority of (80%) respondents always wash their hands after encountering vulnerable situations. However, rinsing hands with soap and running water was always practiced by comparatively less percentage (63%) of respondents. In contrast, some researchers found that rinsing hands with soap and running water was always practiced about 80% of managers (Sani *et al.*, 2014) and this finding is contradictory to this study. Further, 83.3% of respondents claimed that teas were always contacted after washing hands with water, even though 56.7% of respondents stated that they always handled teas after washing hands with running water and thereafter drying. Therefore, there was a comparatively lower percentage of managers who contacted teas with well-dried hands following washing with running water. Nevertheless, most managers consistently adhere to the practice of handwashing. Further, the majority of managers (63.3%) stated that they were covering hair completely during tea processing; however, 6.7% of respondents stated that they wore proper hair covers sometimes not as a routine practice. According to Trafialek *et al.* (2018), food can be secured from hair falling, if food handlers wear any protective hair net. Hence, using protective gear to prevent hair from falling and mingling of them is an important practice for food safety. Similarly, in tea factories in the Uva region, dipping shoes in a

disinfectant solution has always become an act. However, changing shoes was not done as always, if they were subjected to less contamination. Further, it is stated that wearing shoes regularly is associated with dealing with risk factors such as enteropathogenic infections (Yesigat *et al.*, 2020). Hence, immersing the footwear for washing or changing the shoes before entering is required and it is always to practice or else use a shoe cover (El-Nemr *et al.*, 2019).

Correlation between Knowledge, attitude and practice on food safety and hygiene among managers

The KAP model implies that the knowledge of any individual is a key element in influencing his attitudes and practices. Even in the food industry, food handlers' practice is the expected real outcome. It can be reliant on gained knowledge and their own crafted attitude as per the cases. Hence, the association of knowledge, and attitude of managers over safe food handling practices is a criterion to be investigated at any food processing center.

Table 6: Correlation among knowledge, attitude, and practice among respondents (n=30)

	Pearson Correlation Coefficient	P Value
Knowledge – Attitudes	0.421	0.021*
Knowledge - Practices	0.047	0.807
Attitudes – Practices	0.176	0.353

Knowledge, attitude and practice on basic food safety and hygiene among managers are summarized as shown in Table 6. Accordingly, a significant positive linear relationship was observed only between the knowledge with the attitude ($r=0.421$, $p<0.05$). This finding explains that managers' knowledge positively influences their attitudes, but not with the practices in the safe handling of black tea at the processing factories in the Uva region of Sri Lanka. As a manager or an estate manager, he becomes a responsible person for both estate and tea processing centre activities. Even though he handles teas, he does not do it always. Because he is the decision maker and assigned many roles in managing and running the tea estate apart from his role as a food handler. However, many studies have supported the fact that there is a significant positive correlation between the knowledge, attitude and practice of managers who engaged in multi-role of production processes (Al-Shahib *et al.*, 2016; Kunadu *et al.*, 2016; Al-Kandari *et al.*, 2019). In fact, it is well-stated that the manager is the responsible party for making a "food safety culture" within the whole working environment (Al-Kandari *et al.*, 2019). Meantime manager facilitates and creates a food safety

and hygiene-based code of practice, which leads to having a proper food handling environment (Jubayer *et al.*, 2020).

Benefits, constraints and suggestions for adopting FSMS at the black tea manufacturing tea factories

Sri Lankan black tea manufacturing factories have immensely contributed to producing pure quality black teas that guarantee safety and quality. Even though these factories are progressing towards the apparent requirement of adopting FSMS at their factories, they are reaping both benefits and depriving constraints in producing quality-assured Ceylon black teas.

Benefits of implementing FSMS at the black tea manufacturing tea factories

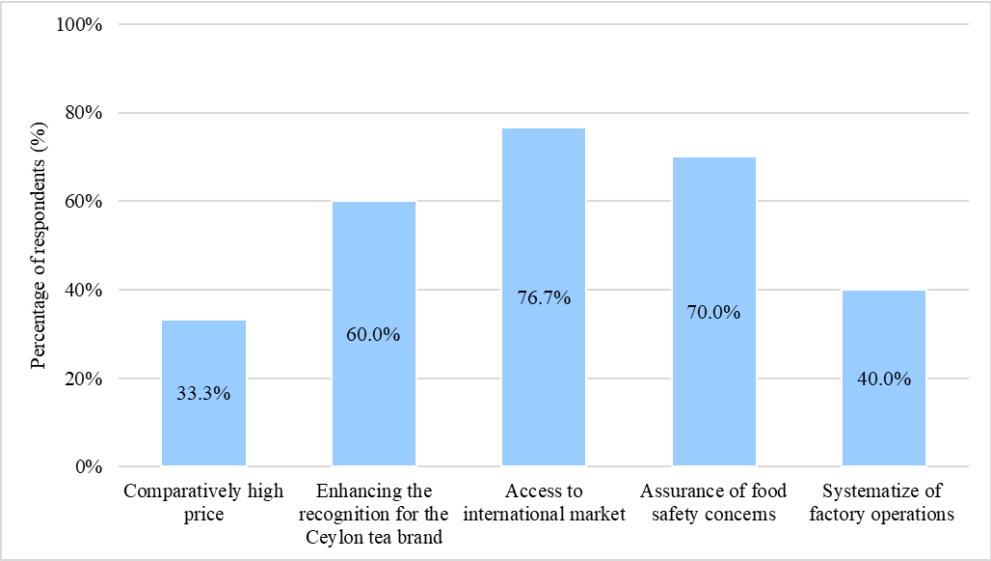

Figure 2: Benefits in implementing FSMS at black tea manufacturing factories

According to Figure 2, managers of these sampled black tea manufacturing factories in the Uva region of Sri Lanka had claimed that implementing ISO 22000 FSMS would benefit by; (i) encouraging access to international markets, (ii) assuring the concerns of food safety, (iii) enhancing the recognition of Ceylon teas, (iv) scrutinize and systematize factory operations, and (v) be a cause to obtain a comparatively high price for black teas by 76.7, 70, 60%, 40, and 33.3%, respectively. The majority of respondents believed that FSMS is a beneficial tool for accessing to international tea market. Similarly, this can be performed as a push strategy in exporting teas to international competitive markets. Secondly, respondents believed that acquiring internationally recognized FSMS for their tea factories was a strategy for endorsing their own

Ceylon teas. Even access to the international market, which was commended for increased market share with access to new markets (Macheka et al., 2013); assurance of food safety concerns; improvement of product quality and safety (Bai et al., 2007; Jin et al., 2008; Macheka et al., 2013); systematization of factory operations; improved employee skills (Macheka et al., 2013); enhancing brand recognition; and earning comparatively high prices/profits (Qiijun et al., 2016; Fotopoulos et al., 2011).

Further, managers had claimed that there were other benefits except for the aforementioned major benefits; (i) reduction of customer complaints (7%), (ii) improvement of the reputation of the company/factory (10%), (iii) minimal wastage with and environment pollution (3.3%), and (iv) aid to promoting Sri Lankan teas (3.3%) with very few responses. However, these benefits were stated in previous studies particularly in reducing the number of fewer customer complaints (Bas *et al.*, 2007; Fotopoulos *et al.*, 2011; Karaman *et al.*, 2012); less waste (Jin *et al.*, 2008; Fotopoulos *et al.*, 2011).

Constraints in implementing FSMS at the black tea manufacturing tea factories

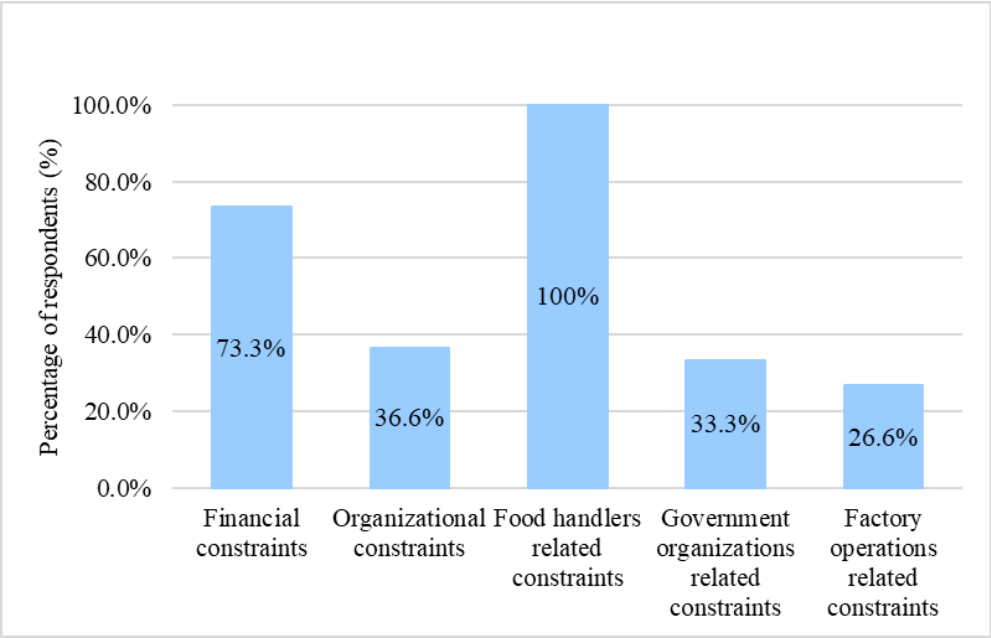

Figure 3: Constraints in implementing FSMS at black tea manufacturing factories

According to Figure 3, constraints encountered in implementing the ISO were identified and those constraints were segregated as (i) food handlers-related constraints, (ii) financial constraints, (iii) organizational constraints, (iv) governmental organization-related constraints, and (v) factory operations related constraints with a percentage of 100, 73.3, 36.6, 33.3, and 26.6%, respectively.

Food handler-related constraints (100%) were identified as the main obstacle, while financial constraints (73.3%) as the second most common hurdle witnessed by the managers; because implementing FSMS has become a real barrier as it requires the cooperation of well-disciplined food handlers who usually practice safe code of conducts within food safety environment at the factory. Also, managers had identified tea handlers' resistance to change, lack of knowledge on food safety, labour shortage and migration, lack of motivation and their living standards influenced in implementing FSMS. Nevertheless, safe tea handling practices are required to be carried out as a continuous process to ensure the safety and quality of teas. In fact, previous studies even witnessed similar and different constraints such as food handlers-related constraints (Macheka *et al*., 2013; Qijun *et al*, 2016), Financial constraints (Qijun *et al.*, 2016; Rincon-Ballesteros *et al.*, 2019), Organizational constraints (Rincon-Ballesteros *et al*., 2019), Government organization related constraints (Fotopoulos *et al.*, 2009), and Factory operations related constraints (Qijun *et al.*, 2016).

Suggestions to overcome constraints in implementing FSMS

Accordingly, 36.6% of respondents claimed that continuous periodical training is an acceptable method of overcoming constraints, and it can be conducted in different forms such as training sessions, awareness programmes, and motivation recreating programmes. Meanwhile, 33.3% of respondents believed that there is a specific role to be performed by the SLTB cooperating with the collaboration of other government institutions in order to mitigate.

However, in previous studies, training is considered a mandated requirement or a recommended approach to encourage food handlers to cope with safe food production (Samapundo *et al*. 2016; Al-Kandari *et al.*, 2018; Allafi *et al*., 2020; Ncube *et al*., 2020; Sirichokchatchawan *et al*., 2020). More specifically, continuous training on food safety is recommended as a productive avenue to encourage practicing safe food handling among food handlers at food processing centres (Alemayehu *et al*., 2021). Because continuous training is a mode of transforming knowledge into practice or behaviour (Lee *et al*., 2017). Further, this training shouldn't be composed of only theoretical components but has to be composed of practically oriented training (Siddiky *et al*., 2022) with appropriate adult learning methods (Vo *et al*., 2015).

CONCLUSIONS

The study concluded that the managers of black tea manufacturing factories in the Uva region of Sri Lanka have satisfactory knowledge, attitude, and practice on food safety. Meanwhile, the level of knowledge of managers influenced their attitudes but not their behaviour regarding food safety. However, even majority of managers had received training on food safety, a continuous periodical but short training could be suggested to sustain the practice of handling teas safely at these tea factories in the Uva region of Sri Lanka. Meanwhile, managers believe that implementing food safety management systems is a strategy that facilitates

their black tea penetration into international market platforms and a tool that assures the food safety of teas. In fact, constraints occurred with the management of food handlers and financial complications were hugely affected in compliance with food safety management systems at these black tea manufacturing factories in the Uva region of Sri Lanka.

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