

Food Safety Knowledge, Attitude and Practices of Orange Fleshed Sweetpotato Puree Handlers in Kenya

Derick Nyabera Malavi^{1,2,3*} George Ooko Abong¹ Tawanda Muzhingi^{2,3}

1. Department of Food Science, Nutrition and Technology, University of Nairobi, P.O Box 29053-00625 Nairobi, Kenya

2. Food and Nutrition Evaluation Laboratory (FANEL), Biosciences for east and central Africa (BeCA), International Livestock Research Institute (ILRI), International Potato Centre (CIP) Sub-Saharan Africa (SSA) Regional Office, Old Naivasha Road, P.O Box 25171-00603, Nairobi, Kenya

3. International Potato Centre (CIP) Sub-Saharan Africa (SSA) Regional Office, Old Naivasha Road, P.O Box 25171-00603, Nairobi, Kenya

Abstract

Orange Fleshed Sweetpotato (OFSP) puree is a nutritious food ingredient for promoting Vitamin A intake in processed food products in Sub-Saharan Africa (SSA). OFSP puree handlers play an important role in ensuring production of consistently safe and quality OFSP puree and related processed products. Lack of or insufficient knowledge on food safety coupled with poor practices by food handlers are major causes of foodborne illnesses and deterioration in food quality along the food chain. The current study assessed levels of food safety knowledge, attitude and hygiene practices (KAP) of OFSP puree handlers in Kenya. A cross-sectional study using a self-administered structured questionnaire was conducted among 35 OFSP puree handlers chosen by exhaustive sampling during the period of July and August 2016. The mean percentage scores for knowledge, attitude, practices and overall KAP were 73, 89, 80 and 81, respectively. OFSP puree handlers in this study had low level of knowledge on personal hygiene, food contamination, foodborne illnesses, cleaning and sanitation with mean scores of 80, 64, 76 and 63%, respectively. Training had a significant impact on knowledge ($p=0.020$), attitude ($p=0.050$), practices ($p=0.006$) and overall KAP ($p=0.001$) with majority of the OFSP puree handlers (63%) having received a training on food safety. A significant moderate positive correlation existed between knowledge and practices ($r=0.358$, $p=0.035$) and attitude and practices ($r=0.42$, $p=0.013$). As per adjusted linear regression analysis, food safety practices significantly ($p=0.045$) increased by 0.32% with one percent increase in knowledge and by 0.38% ($p=0.018$) with one percent increase in attitude. OFSP puree handlers had low level of knowledge and practices but demonstrated a positive attitude on food safety. Frequent food safety training is needed to improve knowledge and hygienic practices of OFSP puree handlers.

Keywords: Food handlers, Foodborne illnesses, Contamination, Personal hygiene

1 Introduction

Orange Fleshed Sweetpotato (OFSP) is an important crop for food security and combating Vitamin A deficiency in Sub-Saharan Africa (SSA) (Low et al., 2007; Low et al., 1999; Low et al., 1997). Sweetpotato roots are highly perishable and this results in huge economic losses through spoilage in most developing African countries that are not able to adopt high technology storage facilities (Oke and Workneh, 2013). OFSP roots are processed into puree that is used in substantial proportion for wheat flour substitution by bakeries in Kenya and other SSA countries. OFSP processing is primarily done by one processor and solely distributed to one of the largest retail stores in Kenya for use in baked products such as bread, scones, doughnuts, cookies and cakes (Tedesco and Stathers, 2015). Value addition involving OFSP puree requires stringent quality control and quality assurance measures to uphold food safety in processing and enhance quality and shelf-life stability of processed products. This is however much dependent on hygienic measures in processing environments and handling practices from food handlers.

Food safety is a public health concern in both developed and developing countries. Foodborne diseases are leading causes of morbidity and mortality, and a significant impediment to socio-economic development worldwide (Hassan et al., 2010; WHO, 2015). For over years, poor food handling and sanitation practices have been major factors for an increase in the number of reported foodborne illnesses in developing countries. The annual surveillance report by Centre for Disease Control and Prevention (CDC, 2015) indicate that 818 cases of foodborne illnesses occurred in the United States and resulted in 13,360 illnesses, 1,062 hospitalizations, 16 deaths, and 14 food recalls in 2013. In another global report by WHO (2015) it is reported that 600 million people suffer from foodborne illnesses worldwide. From this figure, death occurs to 420,000 people of which 125,000 are children under the age of five.

Food handlers play vital roles in ensuring food safety along the food chain. Improper food handling practices and lack of food safety knowledge among food handlers contributes to deterioration in food keeping quality and incidences of foodborne diseases (Sharif et al., 2013; Aluko et al., 2014). It is documented that approximately 10-20% of foodborne disease outbreaks results from contamination by food handlers (Anuradha

and Dandekar, 2014). Lack of food safety knowledge, poor personal and hand washing hygiene are leading causes of food contamination by food handlers (Todd et al., 2007; Tolulope et al., 2014; Baluka et al., 2014). Implementation of good hygiene practices by food handlers is a key element to enhancing food safety in food processing environments. Several studies have been conducted previously to determine knowledge, attitude and practices of food handlers in different countries. A KAP study by Soares et al. (2012) in Brazil indicated that most food handlers had insufficient knowledge on food safety and practices. A similar study in Turkey also demonstrated that food handlers had insufficient knowledge on basic food hygiene (Bas et al., 2006). There is, however, lack of published data on knowledge, attitude and practices of food handlers in Kenya.

Sweetpotato puree is highly susceptible to microbial contamination and inappropriate food handling practices from food handlers has been highlighted as one of the potential source of contamination (Perez-Diaz et al., 2008). There is a need to determine the level of food safety knowledge, attitude and practices of OFSP puree handlers for enforcing food safety; improving keeping quality of the puree and its processed products; and providing information necessary for developing food safety trainings. The objective of the current study was therefore to determine the level of food safety knowledge, attitude and practices of OFSP puree handlers in Kenya.

2 Materials and Methods

2.1 Study Area

The current study was conducted among food handlers both at the puree processing plant in Homa Bay County and at a retail chain supermarket bakery in Nairobi County, Kenya. The puree processing plant and the bakery are the only establishments with OFSP puree handlers in Kenya.

2.2 Study Design, Sampling and Sample size

A descriptive cross sectional study design was employed in July and August 2016. All respondents were enrolled on voluntary and anonymous basis. Exhaustive sampling was used to target all food handlers working both at the puree processing plant and at the bakery. Questionnaires were self-administered to a total of 35 OFSP puree handlers.

2.3 Data Collection

A modified structured KAP questionnaire was designed based on previous similar studies by Mohd.Firdaus Siau et al. (2015); Soares et al. (2012) and Talaei et al. (2015). The first part of the questionnaire captured socio-demographic characteristics of respondents that included gender, age, education level, length of employment in the food industry and training in food safety. The second section included 27 questions with choices being Yes, No and Don't Know covered respondent's food safety knowledge on personal hygiene, foodborne illnesses, food contamination, temperature control, use of personal protective clothing, cleaning and sanitation. The third section had 17 questions that covered food handler's attitude towards food safety on a 5-point likert-type scale with options being Strongly agree, Agree, Don't Know, Disagree and Strongly Disagree. The last section of the questionnaire consisted of 19 food handler's practices questions with options of Always, Sometimes, Rarely and Never. All questionnaires were followed by a face to face interview to validate the accuracy of the responses. The questionnaire clearly stated the information was for research purposes and each respondent was required to sign a consent form.

2.4 Data Analysis

The data was analyzed using Statistical Package for Social Sciences software (IBM SPSS version 20). All food safety knowledge responses were categorized as either correct or incorrect. Each correct answer was awarded one point while incorrect response was awarded zero point. In food safety attitude's section, each positive attitude response was awarded one point and zero point for negative attitude. Similarly, one point was awarded for each appropriate hygiene practice while unhygienic practice was not awarded any point. All correct scores for food safety knowledge, attitude and practices for each respondent were summed up and calculated as a percentage. Frequencies and descriptive statistics were used to summarize scores for each question, knowledge, attitude, practices and overall KAP. The mean scores for knowledge, attitude and practices among respondents in different age groups, education level and length of employment were compared by One-way ANOVA. Independent t-test was used to compare mean scores of knowledge, attitude and practices with respect to gender and training in food safety. Pearson's correlation was used to establish an association of the three study components (KAP). Adjusted linear regression was used to assess the effect of food safety knowledge and attitude on practices. Multiple regression was used to assess the effect of socio-demographic factors (education level, length of employment and training in food safety) on food safety knowledge, attitude and practices. High knowledge, positive attitude and good practice on food safety were considered for mean scores above 80%. Statistical significance was set at $p < 0.05$.

3 Results and Discussion

3.1 Demographic Characteristics of Orange Fleshed Sweetpotato Puree handlers

Table 1 shows demographic characteristics of the respondents. Out of 35 respondents enrolled in the study, 77.1% were male while 22.9% were female. More than half (57.1%) of all OFSP puree handlers were within the age group 26-35 years, 31.4% (18-25 years) and 11.4% (36-60 years). Majority of the respondents (57.1% and 34.3%) had attained tertiary and secondary education respectively with only 8.6% having primary education. More than half of all food handlers (54.3%) had been working in the food industry for a period of 1-5 years, 22.9% for less than a year and the rest (22.9%) for more than 5 years. More than half of the respondents (62.9%) had received a training on food safety while 37.1% had not received any training.

Table 1. Socio-demographic Characteristics of OFSP Puree handlers in Kenya (N=35)

Socio-demographic variables		Frequency (n)	Percentage (%)
Gender	Male	27	77.1
	Female	8	22.9
Age	18-25	11	31.4
	26-35	20	57.1
	36-60	4	11.4
Highest Education level	Primary	3	8.6
	Secondary	12	34.3
	Tertiary	20	57.1
Length of Employment (Years)	Less than 1	8	22.9
	1-5	19	54.3
	Above 5	8	22.9
Training on Food safety	Yes	22	62.9
	No	13	37.1

3.2 Overall Food Safety Knowledge, Attitude and Practices (KAP) of OFSP puree handlers

The mean percentage scores for knowledge, attitude, practice and overall KAP are shown in Figure 1.

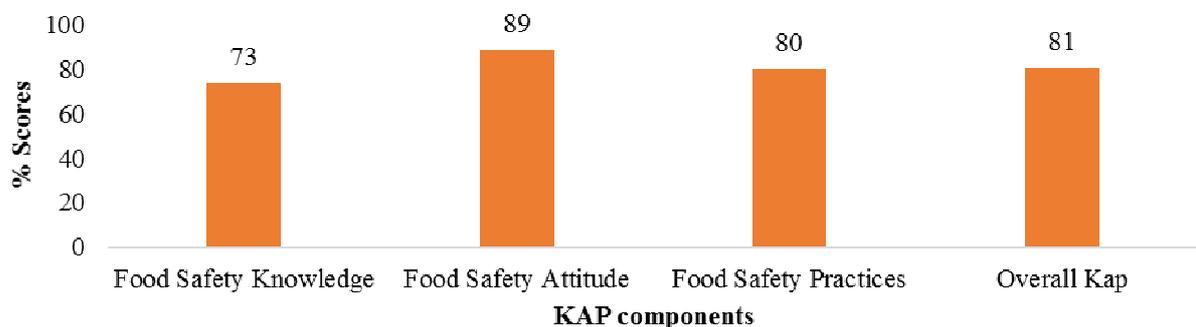


Figure 1. Mean percentage scores for knowledge, attitude, practices and overall KAP

The current findings revealed that OFSP puree handlers demonstrated an overall good level of KAP. A study by Sharif et al. (2013) found that food handlers in military hospitals in Jordan had a good level of KAP with a score of 87.9% ± 9.6%. KAP scores among puree handlers increased with an increase in study-demographic factors but was only statistically different between trained and untrained food handlers (Table 2). This is contrary to other studies that indicated KAP was significantly influenced by factors such as gender, age and education level (Sharif et al., 2013; Talaei et al., 2015; Abdullahi et al., 2016). This could be attributed to non-segregation of job roles based on age, gender and education level of food handlers.

Table 2. Mean scores: Food Safety Knowledge, Attitude, Practices and Overall KAP of OFSP Puree handlers as per demographic characteristics by ANOVA and t-Test

Demographic variable	n	Knowledge		Attitude		Practices		Overall KAP		
		Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value	Mean±SD	p-value	
Gender	Male	27	73.9±9.9	0.578	88.0±8.6	0.470	80.9±23.0	0.540	80.9±11.0	0.684
	Female	8	71.8±8.4		90.4±7.0		75.7±10.9		79.3±5.7	
Age (Years)	18-25	11	68.4±10.0		85.0±10.0		75.6±25.3		76.3±11.6	
	26-35	20	75.7±9.0	0.099	90.0±7.4	0.219	78.7±19.2	0.235	81.5±9.0	0.120
	36-60	4	75.9±7.1		91.2±3.4		96.1±5.0		87.7±4.1	
Education	Primary	3	63.0±9.8		78.4±12.3		68.4±36.5		69.9±15.6	
	Secondary	12	72.2±8.1	0.079	87.3±6.1	0.033*	77.2±24.5	0.480	78.9±11.3	0.073
	Tertiary	20	75.7±9.5		90.9±7.8		82.9±15.9		83.2±7.2	
Employment	< 1 year	8	69.4±7.3		86.0±11.3		65.1±27.0		73.5±13.5	
	1-5 years	19	73.5±10.0	0.262	88.2±7.1	0.354	83.9±17.9	0.075	81.9±8.1	0.057
	> 5 years	8	77.3±9.8		91.9±7.0		84.2±15.4		84.5±7.2	
Training	Yes	22	76.3±8.5	0.020*	90.6±7.2	0.050*	86.8±13.8	0.006*	84.6±6.4	0.001*
	No	13	68.7±9.6		85.1±8.9		67.6±25.4		73.8±11.4	
Mean			73.4±9.5		88.6±8.2		79.7±20.8		80.6±10.0	

* Mean difference significant at the 0.05 level

3.3 Food Safety Knowledge of OFSP Puree handlers in Kenya

OFSP puree handlers had low level of knowledge on food safety with a percentage mean score of 73.4±9.5. Male respondents had a higher knowledge score (73.9±9.9) compared to females (71.8±8.4) but it was not statistically significant ($p=0.58$). Food safety knowledge scores increased with age, education level, employment period and training in food safety. Respondents within the age of 26-35 years and 36-60 years demonstrated identical knowledge scores of 75.7±9.0 and 75.9±7.1, respectively while those between 18 and 25 years expressed a low mean score of 68.4±10.0. The scores were, however, not influenced by age differences ($p=0.10$). Food handlers with college/university education showed high knowledge on food safety (75.7±9.5), followed by those with secondary education (72.2±8.1) and lastly, by those with primary education (63.0±9.8). The difference in their knowledge scores was not significant ($p=0.08$ and $F=2.753$). Food handlers with a considerably long work experience in the food industry (> 5years) had high knowledge score of 77.3±9.8 followed by those with 1-5 years of experience (73.5±10.0) and lastly by those with less than a year of work experience (69.4±7.3). Their difference in scores were not statistically different ($p=0.262$ and $F=1.397$). Food handlers with a training in food safety displayed high knowledge score (76.3±8.6) compared to those who had not received any training (68.7±9.6). The difference in their scores was statistically different ($p=0.020$). Other studies have found food handler's knowledge being influenced by gender (Sharif et al., 2013), age (Rahman et al., 2012) and education level (Talaie et al., 2015). It is well documented that training significantly improves knowledge and practices of food handlers (Park et al., 2010). The current study showed that trained food handlers had a better knowledge as compared to untrained food handlers. Similar results have been reported by Bas et al. (2006). On the contrary, another KAP study by Soares et al. (2012) in Brazil reported insufficient knowledge by food handlers despite majority of them having attended a training in food safety. Food handlers should be trained from time to time to improve their knowledge and practices on food handling (Rennie, 1995). OFSP puree handlers demonstrated good knowledge on food process temperature control but low level of knowledge on personal hygiene, foodborne illnesses, food contamination, cleaning and sanitation (Figure 2).

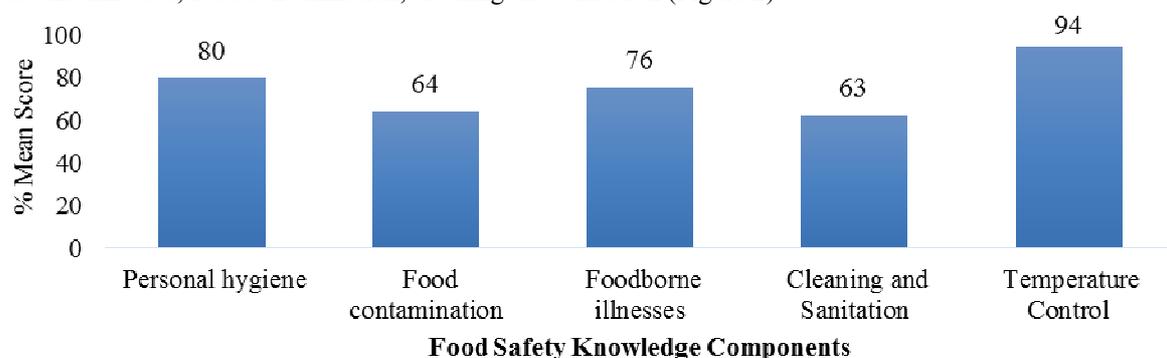


Figure 2. Mean percentage scores for main food safety knowledge components

Table 3 shows food safety knowledge responses by Orange Flashed Sweetpotato puree handlers in the

current study.

Table 3. Food Safety Knowledge responses by OFSP Puree handlers in Kenya (N=35)

Food Safety Questions	With Knowledge (%)	Without Knowledge (%)
1. Preparation of food disregarding hygiene rules causes food-borne illnesses	97.1	2.9
2. Food borne diseases are transmitted by food contamination	97.1	2.9
3. Food borne diseases are transmitted by contaminated water	71.4	28.6
4. Improper heating of food causes food-borne illnesses	71.4	28.6
5. During infectious disease of the skin, it is necessary to take leave from work	91.4	8.6
6. Only sick people carry bacteria which causes food poisoning	91.4	8.6
7. Microbes are in the skin, nose and mouth of healthy food handlers	100	0.0
8. Children, healthy adults, pregnant women and older individuals are at equal risk for food poisoning	85.7	14.3
9. Typhoid fever can be transmitted by food	57.1	42.9
10. Food production staff should have health checkups every two years	40.0	60.0
11. Contaminated food can be detected by taste	42.9	57.1
12. Washing hands before work reduces the risk of food contamination	100	0.0
13. Working without protective clothing in is sometimes allowed in a food factory	77.1	22.9
14. Using gloves while handling food reduces the risk of food contamination	91.4	8.6
15. Eating and drinking in the work place increases the risk of food contamination	71.4	28.6
16. Proper cleaning and sanitization of equipment reduces the risk of food contamination	85.7	14.3
17. Working with jewelry is allowed in a processing plant	88.6	11.4
18. Washing equipment with detergent does not completely leave them free from contamination.	31.4	68.6
19. Clean is the same as sanitize	51.4	48.6
20. Cleaning chemicals and food ingredients should be kept together in one store	85.7	14.3
21. Food can be prepared on dirty surfaces/equipment	97.1	2.9
22. Cleaning of equipment should always be done at the end of processing	40.0	60.0
23. Cross contamination is when microorganisms from a contaminated food are transferred by the food handler's hands or kitchen utensils to another food	68.6	31.4
24. Contaminated foods can be detected by changes in color, odor or taste	31.4	68.6
25. Raw food and processed food should be kept separate	94.3	5.7
26. Temperature control is important in storage and processing of safe food	97.1	2.9
27. Temperature readings for equipment and other installations like refrigerators should be checked and recorded from time to time	91.4	8.6

Less than half of the respondents (31.4%) correctly answered that contaminated food cannot be detected by changes in color, odor or taste and 68.6% knew several routes of food contamination. Approximately half (48.6%) of the food handlers couldn't differentiate between cleaning and sanitation. Additionally, 68.6% didn't know only cleaning without sanitation cannot eliminate disease causing microorganisms from food surface equipment. Inappropriate personal hygiene practices and inefficient cleaning and sanitation of equipment are key factors leading to food contamination and incidences of foodborne diseases (Todd et al., 2007). In comparison with a similar study by Bas et al. (2006), food handlers had poor scores on overall food safety knowledge, personal hygiene, cross-contamination, food poisoning and temperature control. It should also be emphasized that appropriate control and monitoring of process parameters such as processing and storage temperatures is necessary in destroying or reducing microorganisms in food to a level safe for consumption and shelf life stability.

3.4 Food Safety Attitude of OFSP Puree handlers in Kenya

Food handlers' attitude is also an important factor in controlling incidences of foodborne illnesses and improving quality of processed foods. Positive behavior, attitudes and continuous education among food handlers have been

highlighted as key factors for consistent safe food handling practices (Howes et al., 1996). OFSP puree handlers had a positive attitude towards food safety with a percentage mean score of 88.6 ± 8.2 . Female respondents had a higher attitude score (90.4 ± 7.0) than male respondents (88.0 ± 8.6) but it was not significant ($p=0.470$). Similar findings have been reported by Sharif et al. (2013) and Konaklioglu (2012). Attitude scores increased with age, education level, length of employment and training in food safety. Respondents within the age brackets of 18-25, 26-35 and 36-60 years scored 85.0 ± 10.0 , 90.0 ± 7.4 , 91.2 ± 3.4 respectively but their mean scores were not statistically different ($p=0.219$ and $F=1.591$). The level of attitude scores significantly varied with respondent's level of education ($p=0.033$ and $F=3.784$). The mean attitude scores for puree handlers with primary, secondary and tertiary education were 78.4 ± 12.3 , 87.3 ± 6.1 , 90.9 ± 7.8 , respectively. Food handlers with more than 5 years of work experience in the food industry expressed a high positive attitude towards food safety (91.9 ± 7.0), followed by those with 1 to 5 years' work experience (88.2 ± 7.1) and lastly 86.0 ± 11.3 for respondents who had worked in the food industry for less a year. Their scores were, however, not statistically different ($p=0.354$ and $F=1.072$). Training on food safety had a significant impact on attitudes ($p=0.050$). Food handlers with a good education and training in food safety are more likely to exhibit positive food safety behavior and consequently better practices. Several studies by Soon et al. (2012), Park et al. (2010) and Rosmawati et al. (2016) have also reported positive attitude from food handlers with a good education level and training in food safety. Responses on food safety attitudes by OFSP puree handlers are shown in Table 4.

Table 4. Frequency of scores on Food Safety Attitudes by Orange Fleshed Sweetpotato Puree handlers in Kenya (N=35)

Statements on food safety attitude	Positive attitude (%)	Negative Attitude (%)
1. Food safety is everyone's responsibility	100	0.0
2. Safe food handling is an important part of my job responsibilities	100	0.0
3. Learning more about food safety is important to me	97.1	2.9
4. I believe that how I handle food relates to food safety	100	0.0
5. Well processed foods are free of contamination	68.6	31.4
6. Proper hand hygiene can prevent food-borne diseases	88.6	11.4
7. Raw and processed food should be stored separately to reduce the risk of food contamination	100	0.0
8. It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination	85.7	13.3
9. The health status of workers should be evaluated before employment	97.1	2.9
10. Wearing a mask is an important practice to reduce the risk of food contamination	54.3	45.7
11. Wearing gloves is an important practice to reduce the risk of food contamination	97.1	2.9
12. Food handlers who have abrasions or cuts on their hands should not touch food without gloves.	85.7	14.3
13. It is unnecessary to have medical examination because am healthy	88.6	11.4
14. You can keep working with exposed body cut or hand injury	62.9	37.1
15. PPE/Apron can be used to clean dirty hands	80.0	20.0
16. I can scratch or rub my skin while working	100	0.0
17. I can chew/smoke while working	100	0.0

From food safety attitude responses (Table 4), all OFSP puree handlers agreed that embracing food safety was everyone's responsibility and how they handled food largely contributed to food safety. Majority of the food handlers (88.6%) believed proper hand hygiene and use of gloves (97.1%) reduced the risk of food contamination. However, only 68.6% believed that well processed foods were free of contamination and 37.1% believed they could handle food with exposed body cuts, lesions or handy injury. Appropriate personal hygiene is an important practice in controlling food contamination. Food handlers can be vectors of potent pathogens such as *Staphylococcus aureus* and *Escherichia coli* (Mahmoud and Sivakumar, 2014; Anuradha and Dandekar, 2014). Approximately 90% of all food handlers believed proper hand hygiene prevents food-borne diseases. Similar results were reported by Soares et al. (2012) where 96.4% of food handlers agreed hand hygiene was an important practice in preventing foodborne illnesses.

3.5 Food Safety Practices of OFSP Puree handlers in Kenya

Besides knowledge and attitude, food safety is highly dependent on food handling practices. Several cases of food borne illnesses are attributed to inappropriate food handling practices by food handlers. OFSP puree handlers in the current study demonstrated poor food handling practices with a mean score of 79.7 ± 20.8 . Better practices were demonstrated by male respondents (80.9 ± 23.0) as compared to female respondents (75.7 ± 10.9) but it was not significant ($p=0.540$). This could be due to male food handlers being involved in several

operations during production. This is contrary to findings of Hassan and Dimassi, (2014). Food safety practices increased with age, level of education, length of employment and training in food safety. Food handlers within the age brackets of 18-25, 26-35 and 36-60 years had practice mean scores of 75.6±25.3, 78.7±19.2 and 96.1±5.0 respectively. The difference in their scores was not statistically different ($p=0.235$ and $F=1.515$). Respondents with tertiary education demonstrated good practices (82.9±15.9) as compared to those with secondary (77.2±24.5) and primary education (68.4±36.5). Their mean score difference was not significant ($p=0.480$ and $F=0.751$). Food handlers with less than 1 year, 1-5 years and above 5 years of experience had practice mean scores of 65.1±27.0, 83.9±17.9 and 84.2±15.4 respectively and were not significantly different ($p=0.075$ and $F=2.808$). Food safety training influenced food safety practices ($p=0.006$). Respondents with a training in food safety demonstrated good practices with a mean score of 86.8±13.8 compared to untrained food handlers who expressed weak practices with a score of 67.6±25.4. Similar to knowledge and attitude, food handlers practices can be improved through food safety training (Roberts et al., 2008; Park et al., 2010; Kassa et al., 2010; Soon et al., 2012). Poor practice scores by puree handlers were observed on personal protective clothing items (Table 5).

Table 5. Frequency of scores on Food Safety Practices by Orange Fleshed Sweetpotato Puree handlers in Kenya (N=35)

Food Safety Practices Questions	Appropriate Practice (%)	Inappropriate practice (%)
1. Do you wear jewelry and a watch while working?	85.7	14.3
2. Do you rub your hands on your face, hair etc. while working?	77.1	22.9
3. Do you smoke/chew gum while working?	91.4	8.6
4. Do you use detergent whenever you wash your hands?	80.0	20.0
5. Do you wash your hands with soap after visiting the toilet?	85.7	14.3
6. Do you use gloves when you touch or distribute unwrapped foods?	74.3	25.7
7. Do you wash your hands before wearing gloves?	54.3	45.7
8. Do you wash your hands after using gloves?	65.7	34.3
9. Do you wear nail polish when handling food?	97.1	2.9
10. Do you wear an apron/PPE while working?	85.7	14.3
11. Do you use protective clothing when you touch or distribute unwrapped foods?	82.9	17.1
12. Do you wash your hands before touching unwrapped raw foods?	68.6	31.4
13. Do you wash your hands before touching unwrapped cooked foods?	85.7	14.3
14. Do you wash your hands after touching unwrapped cooked foods?	80.0	20.0
15. Do you wipe your hands with your apron/PPE?	68.6	31.4
16. Do you clean your working area before food preparation?	80.0	20.0
17. Do you check shelf life of foods/ingredients at the time of delivery?	88.6	11.4
18. Do you check the packing integrity of foods at the time of dispatch/delivery?	80.0	20.0
19. Do you properly clean the food storage area before storing new products?	82.9	17.1

Most of the respondents (85.7%) did not wear any jewelry while handling food; 85.7% washed their hands with soap every time after visiting the toilet; 74.3% used gloves to handle food; 54.3% washed their hands before wearing gloves and 68.6% did not wipe their hands with their aprons. Good personal hygiene by food handlers is crucial in controlling personnel to food contamination during food processing, storage and distribution.

3.6 Correlation of food safety knowledge, attitude and practices of OFSP puree handlers

Food safety knowledge, attitude and practices were positively associated in this study. From Pearson's correlation analysis (Table 6), a moderate positive correlation ($r=0.415$) existed between food safety attitudes and practices ($p=0.013$) and between food safety knowledge and practices ($r=0.358$, $p=0.035$). A weak positive correlation ($r=0.110$) existed between food safety knowledge and attitudes but it was not statistically different ($p=0.531$). A study by Ansari-Lari et al. (2010) reported a positive correlation between knowledge and attitude but a negative association between knowledge and practices as well as attitude and practices.

Table 6. Correlation among knowledge, attitudes and practices of OFSP puree handlers in Kenya (N=35)

Level	Pearson Correlation (r)	p value
Knowledge-Attitude	0.110	0.531
Attitude-Practices	0.415*	0.013
Practices-Knowledge	0.358*	0.035

*Correlation significant at the 0.05 level (2-tailed)

3.7 Effect of food safety knowledge and attitude on food safety practices

Adjusted linear regression (Table 7) was used to assess the effect of food safety knowledge and attitude on food safety practices. Food safety knowledge had a significant impact on both attitude and practices ($p=0.006$ and $F=5.948$). An increase in food safety knowledge by 1%, increased food safety practices by 0.316% ($p=0.045$). Similarly, an increase in food safety attitude by 1% significantly ($p=0.018$) increased food safety practices by 0.380%. An increase in food safety knowledge and attitude significantly improved food handling practices. It can therefore be predicted that an increase in one KAP component ultimately leads to an improvement in the other associated factor (s). This scenario has previously been reported by Mendagudali et al. (2016) and Bendigeri, (2016).

Table 7. Adjusted linear regression assessing the effect of food safety knowledge and attitude on food safety practices

Variables	Coefficient	Std Error	p-value
Knowledge	0.316*	0.332	0.045
Attitude	0.380*	0.386	0.018

$R^2=0.225, F=5.948, p=0.006$

*Variable significant at the 0.05 level (2-tailed)

3.8 Effect of education level, length of employment and food safety training on food safety knowledge, attitude and practices

A combination of prognostic factors (education level, length of employment and training in food safety) had a significant impact on knowledge, attitude and practices (Table 8).

Table 8. Adjusted multiple regression assessing the effect of education level, length of employment and food safety training on food safety knowledge, attitude and practices.

Variables	Food safety knowledge			Food safety attitude			Food safety practices		
	Coefficient	Std Error	p-value	Coefficient	Std Error	p-value	Coefficient	Std Error	p-value
Education level	0.242	2.532	0.177	0.337	2.179	0.064	0.027	1.046	0.876
Employment period	0.088	2.473	0.623	0.038	2.128	0.831	0.169	1.022	0.348
Food safety training	-0.287	3.341	0.105	-0.219	2.876	0.214	-0.385	1.381	0.031*

$R^2=0.225, F=3.004, p=0.045$ $R^2=0.223, F=2.970, p=0.047$ $R^2=0.233, F=3.143, p=0.039$

*Coefficient factor significant at the 0.05 level (2-tailed)

An increase in education level, length of employment and training increased food safety knowledge by 0.24%, 0.09% and 0.29%, respectively ($p=0.045, F=3.004$). Similarly, an increase in these factors increased food safety attitudes by 0.34%, 0.04% and 0.22%, respectively ($p=0.047, F=2.970$). Training in food safety had an impact in improving food safety practices ($p=0.039$). A combination of these predictive factors improved food safety practices by 0.03%, 0.17% and 0.39%, respectively ($p=0.039, F=3.143$). It can arguably be stated that an increase in education level, work experience and food safety training by food handlers significantly leads to an increase in food safety knowledge, attitude and practices. A related KAP study by Talaei et al. (2015) found that education and job category factors together had a significant on knowledge, attitude and practices of food handlers.

4 Conclusion

The findings from the current study indicate that OFSP puree handlers have low level of knowledge and practices on food safety. The study suggested the need to develop and conduct an effective food safety training to improve food safety knowledge, hygiene and handling practices of OFSP puree handlers for enhancing the safety and quality of OFSP puree and processed foods from OFSP puree.

Acknowledgments

The authors would like to thank the International Potato Centre (CIP-SSA) through the projects Scaling Up Sweetpotato Through Agriculture and Nutrition (SUSTAIN) and Sweetpotato Action for Security and Health in Africa (SASHA) for funding this research. We also thank food handlers from OFSP puree processing plant and the bakery for their participation in this study.

References

- Abdullahi, A., Hassan, A., Kadarman, N., Saleh, A., Baraya, Y.S., and Lua, P.L. (2016). Food safety knowledge, attitude, and practice toward compliance with abattoir laws among the abattoir workers in Malaysia. *International Journal of General Medicine*, 9: 79-87.
- Aluko, O.O., Ojeremi T.T., Olaleke, D.A., and Ajidagba, E.B. (2014). Evaluation of food safety and sanitary practices among food vendors at car parks in Ile Ife, southwestern Nigeria. *Food Control*, 40: 165-71.

- Ansari-Lari, M., Soodbakhsh, S., and Lakzadeh, L. (2010). Knowledge, attitudes and practices of workers on food hygienic practices in meat processing plants in Fars, Iran. *Food Control*, 21: 260-263.
- Anuradha, M., and Dandekar, R.H. (2014). Knowledge, Attitude and Practice among food handlers on food borne diseases: A hospital based study in tertiary care hospital. *International Journal of Biomedical and Advance Research*, 3809: 5-7.
- Baluka, S.A., Miller, R., and Kanene, J.B. (2015). Hygiene practices and food contamination in managed food service facilities in Uganda. *African Journal of Food Science*, 9 (1): 31-42.
- Bas, M., Ersun, S.A., and Go Khan Kivanc, G. (2006). The evaluation of food hygiene knowledge, attitudes, and practices of food handlers in food businesses in Turkey. *Food Control*, 17: 317-322.
- Bendigeri, N. A. D. (2016). Knowledge, attitude, and practices of food safety among women of Khaza bazar, the urban field practice area of KBN Institute of Medical Sciences. *International Journal of Medical Science and Public Health*, 5 (3), 516-20.
- Centers for Disease Control and Prevention (CDC) (2015). Surveillance for Foodborne Disease Outbreaks, United States, 2013, Annual Report. Atlanta, Georgia: US Department of Health and Human Services, CDC, 2015. https://www.cdc.gov/foodsafety/pdfs/2015FoodBorneOutbreaks_508.pdf. [Accessed November 18, 2016 at 0815 hrs].
- Hassan, A.N., Farooqui, A., Khan, A., Yahya, K.A., and Kazmi, S.U. (2010). Microbial contamination of raw meat and its environment in retail shops in Karachi, Pakistan. *Journal of Infection in Developing Countries*, 4: 382-388.
- Hassan, H. F., and Dimassi, H. (2014). Food safety and handling knowledge and practices of Lebanese university students. *Food Control*, 40 (1): 127-133.
- Howes, M., McEwen, S., Griffiths, M., and Harris, L. (1996). Food handler certification by home study: Measuring changes in knowledge and behavior. *Dairy, Food and Environmental Sanitation*, 16: 737-744.
- Kassa, H., Silverman, G. S., and Baroudi, K. (2010). Effect of a Manager Training and Certification Program on Food Safety and Hygiene in Food Service Operations. *Environmental Health Insights*, 4: 13-20.
- Konaklioglu, N.S.E. (2012). Food safety knowledge, attitude and food handling practices of students. *British Food Journal*, 114 (4): 469-480.
- Low, J.W., Hagenimana, V., Anyango, O.M., Njoroge, S.M., Gichuki, S. T., and Kabira, J. (1999). Effects of Women Farmers' Adoption of Orange-Fleshed Sweet Potatoes: Raising Vitamin A Intake in Kenya.
- Low, J.W., Arimond, M., Osman, N., Cunguara, B., Zano, F., and Tschirley, D. (2007). A Food-Based Approach Introducing Orange-Fleshed Sweet Potatoes Increased Vitamin A Intake and Serum Retinol Concentrations in Young Children in Rural Mozambique. *Journal of Nutrition*, 137: 1320-1327.
- Mahmoud, I. Y., and Sivakumar, N. (2014). Staphylococcus aureus Contamination during Food Preparation, Processing and Handling. *International Journal of Chemical Engineering and Applications*, 5 (5): 388-392.
- Mendagudali, R.R., Akka, D.K., Swati, A.I., Shedole, D.T., and Bendigeri, D.A.N. (2016). Knowledge, attitude, and practices of food safety among women of Khaza bazar, the urban field practice area of KBN Institute of Medical Sciences, Kalaburagi, Karnataka. *International Journal of Medical Science and Public Health*, 5 (3): 516-520.
- Mohd. Firdaus Siau, A., Son, R., Mohhiddin, O., Toh, P.S. and Chai, L.C. (2015). Food court hygiene assessment and food safety knowledge, attitudes and practices of food handlers in Putrajaya. *International Food Research Journal*, 22(5): 1843-1854.
- Nik Rosmawati, N.H., Muda, W.M.W., Jamil, N.I.N., Hanafi, N.N.N., and Rahman, R.A. (2016). Effect of food safety training on food handlers' knowledge and practices A randomized controlled trial. *British Food Journal*, 118 (4): 795-808.
- Oke, M.O., and Workneh, T.S. (2013). A review on sweet potato postharvest processing and preservation technology. *International Journal of Agricultural Research and Reviews*, 1 (1): 1-14.
- Park, S., Kwak, T., and Chang, H. (2010). Evaluation of the food safety training for food handlers in restaurant operations. *Nutrition Research and Practice*, 4 (1): 58-68.
- Perez-Diaz, I.M., Truong, V., Webber, A., and McFeeters, R.F. (2008). Microbial Growth and the Effects of Mild Acidification and Preservatives in Refrigerated Sweet Potato Puree. *Journal of Food Protection*, 71 (3): 639-642.
- Rahman, M., Arif, T.M., Bakar, K., and Tambi, Z. (2012). Food safety knowledge, attitude and hygiene practices among the street food vendors in Northern Kuching city, Sarawak. *Borneo Science*, 31: 95-103.
- Rennie, D. M. (1995). Health education models and food hygiene education. *Journal of the Royal Society of Health*, 115: 75-79.
- Roberts, K. R., Barrett, B. B., Howells, A. D., Shanklin, C. W., Pilling, V. K., and Brannon, L. A. (2008). Food Safety Training and Foodservice Employees' Knowledge and Behavior. *Food Protection Trends*, 28 (4): 252-260.
- Sharif, L., Obaidat, M.M., Al-Dalalah, M. (2013). Food Hygiene Knowledge, Attitudes and Practices of the

- Food Handlers in the Military Hospitals. *Food and Nutrition Sciences*, 4: 245-251.
- Soares, L.S., Almeida, R.C.C., Cerqueira, S.E., Carvalho, J.S., and Nunes, L.I (2012). Knowledge, attitudes and practices in food safety and the presence of coagulase- positive staphylococci on hands of food handlers in the schools of Camacari, Brazil. *Food Control*, 27: 206-213.
- Soon, J.M., and Baines, R.N. (2012). Food safety training and evaluation of handwashing intention among fresh produce farm workers. *Food Control*, 23 (2): 437-448.
- Talaei, M., Holakouie-Naienib, K., Foroushanib, R.A., and Aslc, M.H. (2015). Knowledge, attitude and practice of people about foodborne outbreak in Isfahan city, Iran. *Journal of Food Safety and Hygiene*, (2): 1-7.
- Tedesco, I., and Stathers, T. (2015). Sweetpotato value chains in Kenya: a business opportunity for puree processing and the potential role for commercial fresh root storage. NRI report, February 2015, University of Greenwich, Chatham: UK. 117.
- Todd, E.C., Greig, D. J., Bartleson, C.A., and Michaels, B. S. (2007). Outbreaks Where Food Workers Have Been Implicated in the Spread of Foodborne Disease, Part 3. Factors Contributing to Outbreaks and Description of Outbreak Categories. *Journal of Food Protection*, 70 (9): 2199-2217.
- Tolulope, O.A., Zuwaira, I.H., Danjuma, A.B., Yetunde, O.T., Chundung, A.M. and Ayuba, I.Z (2014). Training: a vital tool for improving the knowledge and practice of food safety and hygiene among food handlers in boarding schools in Plateau state. *Journal of Tropical Medicine*, 16 (2): 87-92.
- WHO (2015). Estimates of the Global burden of foodborne diseases; foodborne diseases burden epidemiology reference group 2007-2015. http://www.who.int/foodsafety/publications/foodborne_disease/fergreport/en/ [Accessed December 7, 2016 at 1213 hrs].