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Environmental Conditions of Food Preparation Areas in University Catering Units in Kenya

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Abstract

Environmental conditions are crucial in any food preparation area owing to the sensitive nature of food and its effects on human health if not handled well. Good environmental condition in food preparation areas can result in higher productivity, faster service, more economical working, and most of all, better quality of food. The purpose of this study was to assess environmental conditions of kitchens in University catering units. Seven catering units of Moi University within Eldoret town in Kenya were targeted. A qualitative approach using exploratory research design was adopted. An observation schedule was used to collect data through non-participant observation. Census sampling of the seven catering units of Moi University formed the unit of analysis. A dichotomous scale with "yes and no" options were used to score the aspects that were used to measure prevailing conditions in the kitchens. Cronbach's Alpha used to test reliability of the items found the significance level at 0.7. Descriptive statistics, factor analysis and Pearson correlation were used to analyse data. Results from factor analysis indicated that out of twenty five items used to measure environmental conditions of food preparation areas, only six components were extracted. The six components include physical aspects, fittings made in the kitchen, arrangement aspects in the kitchen, the atmosphere in the kitchen, provisions considered for the kitchen and cleanliness aspects. Pearson correlation measured the degree of the relationships between and six components which showed that all the relationships tested were not significant except for the relationship between physical aspects and atmosphere.

Keywords: Catering, Environmental, Food Preparation, Units, University

INTRODUCTION

Food an important basic necessity is a critical contributor to physical well-being and a major source of pleasure (Rozin *et al.*, 1999). Consequently, its preparation is vital for sustenance of life. However, if food preparation areas are not well planned and designed, diseases easily spread through food contamination which can result in appreciable morbidity and occasionally in death (Scharff, 2009; Tomohide, 2010). Over the years, increased cases of cholera, typhoid and diarrhea outbreaks continue to be reported the world over. According to WHO (2011) data, diarrheal disease deaths in Kenya reached 27,614 or 8.69% of the total deaths. That is a rate of 56.98 per 100,000 of the population. Kenya was ranked at number 41 in the world. Kenya National Statistics for cases of diarrhea indicate that in the year 2011, there were 1,194,167 under five years, and 859, 288 over five years, cases of diarrhea. In the year 2012, there were 1,176, 967 under five years, and 904, 224 over five years, cases of diarrhea, in Kenya. Most of these cases can be attributed to contaminated food. Other studies have demonstrated that food plays an even greater role than water in causing this infection as many foods support the growth of *V. cholera* to disease causing levels and may protect the

microorganism from gastric acidity (WHO, 2000).

Analyses of food borne disease notifications worldwide have shown that the majority of outbreaks result from malpractice during food preparation in small food businesses, canteens, residential homes, and other places where food is prepared for human consumption (Motarjemi and Mortimore, 2005). While it has long been considered that most cases of diarrhea in developing countries are waterborne, Keferstein (2006) asserted that it is a grave mistake to ignore the role of contaminated food and that there is an urgent need to integrate food safety, along with water and sanitation programs, as an essential strategy to prevent diarrhea. Although numerous control strategies are in place, person to person disease transmission has not ceased. Catering units have become an integral part of University operations as the number of students and staff increases, the number of diners also continues to escalate and so has the number of food borne illness outbreaks as a result of food prepared in questionable environments. Food safety as observed by Scheule *et al.,* (2001) and Badrie *et al.,* (2006) remains a critical issue among professionals in the food service sector as well as among consumers.

Poor food handling practices and unclean kitchen environments make good habitat for microorganisms which lead to illness, unhappy customers and even fines, summons and law suits, besides, food spoilage and raising food costs. Githiri *et al., (*2009) found that possible contamination of food served to patients by food handlers as a concern in the role of food handlers (staff). Moreover, few studies undertaken by Githiri *et al., (*2009); Muinde and Kuria, (2005) and Oloo, (2010) assessed the roles played by environmental conditions of food preparation in the transmission or control of food borne diseases in various settings. In particular, there is a paucity of knowledge of food safety in special settings especially the university cafeteria that prepares meals for students and staff. The scope of burden and costs emanating from unsafe food remains unknown in Kenya (WHO, 2008). Statistics available in Kenya on food borne diseases are poorly analyzed and skimpy in documentation (Oloo, 2010). Moreover, there is no separate documentation in records of disease burden making it intricate to segregate the intensity of food borne diseases from other diseases. In the year 2008, 56 cases of diarrheal disease outbreaks were reported in Moi University, main campus (Moi University Health Unit records). This could be attributed to environmental conditions surrounding food preparation. Therefore, the purpose of this study was to assess environmental conditions of University catering units.

According to Sethi, (2008) different types of food used by an establishment need separate storage conditions for maintaining their wholesomeness and expected shelf life. This is because foods vary in their moisture content, acidity and temperature according to which they become susceptible to spoilage or remain wholesome. Storage conditions need to ensure the food does not become hazardous to health while in storage. Different food items must be stored in a particular order in walk-in refrigeration units or stand-up refrigeration units in the kitchen. Food handlers must be aware of where they are placing particular food items when storing them in the refrigerator. There are two different types of bacteria that are found in refrigerated foods. Pathogenic bacteria induce food borne illnesses and spoilage bacteria cause food to deteriorate and develop bad odors, tastes, and textures (USDA, 2010). Due to pathogenic bacteria in food, food items must be placed in the refrigeration unit in a particular order. Cooked and Ready To Eat (RTE) food items are stored above raw items to prevent cross-contamination in the instance that the raw items potentially drip.

Raw meat dishes should be well stored and in acceptable temperature to avoid spoilage. The temperature to be maintained in a particular store will depend on the type of food to be

held and the period for which they have to be stored. In general, most bacteria are inactivated at freezing point i.e. 0^{H}C and below. Between 1.7°C and 4.4°C they start becoming active slowly as the temperature rises, the activity increases, and becoming optimum at 37°C which is the normal body temperature (Sethi 2008). Work stations, utensils, and equipment used for food preparation must be cleaned and sanitized before they become in contact with RTE foods. In food safety, the term clean is defined as free of visible soil and the term sanitary is defined as the number of microorganisms on the surface that has been reduced to safe levels (National Restaurant Association Educational Foundation (NRAEF) 2004). Every time work areas, utensils, and equipment are used by a food handler, it must be cleaned and sanitized to prevent cross-contamination. Food can become contaminated through direct or indirect contact with pathogenic food items. Surfaces that have direct contact with food are those that food is placed directly while indirect surfaces can be used to either drip or drain food during preparation (NRAEF, 2004).

A food borne illness outbreak investigation in Oklahoma found that 14 out of 25 people had contracted *Campylobacter jejuni* from cross-contaminated food item of lasagna, which was prepared after a cook had cut raw chicken and inadequately washed the work area and utensils (Graves *et al.*, 1998). Cross-contamination of produce and raw meat is more common in produce (McCabe-Sellers and Beattie, 2004). Different food items should not be prepared close to each other nor the same equipment be used to prepare different food without cleaning. Food preparation areas should be well designated for different forms of food in order to minimize cross contamination. If an establishment has limited space and working surface areas in the kitchen, use of different coloured chopping boards can be used. The area and equipment used to prepare RTE foods must be cleaned and sanitized, and then the food handler may use the same area to prepare raw food items. Food establishments may also assign specific pieces of equipment or color coded equipment to prepare only raw foods or only RTE foods with. Colored cutting boards used for food preparation can designate red for prepping red meats, yellow for poultry, and green for vegetables or fruits. Despite the fact that food items can be prepared using particular equipment, it is not obvious that prevention of cross contamination resulting from microorganisms is being prevented. Food preparation personnel need to ensure proper cleaning then sanitizing of surfaces after food preparation (NRAEF, 2004). Time / temperature abuse while preparing food is known to result in food borne illness (McSwane, Rue, Linton, & Williams, 2004). Time/temperature abuse occurs when food has been allowed to stand for an extended period of time at temperatures favorable for bacterial growth (NRAEF, 2004).

METHODOLOGY

The study was undertaken in Moi University, Eldoret where the target population was seven catering units. This study was qualitative in nature with exploratory research design adopted as the research aimed at assessing the environmental conditions of food preparation. Census sampling was used as all the catering units were included in the sample. Observation schedules were used to collect data using non-participant observation. This was assumed to be the best tool as all items being measured are tangible and static hence there was no need to survey or make any inquiries. The questions in the observation schedule required indication of either "yes or no" as existence or non-existence of the item. Reliability was tested using Cronbach's alpha at a level of 0.6 and the limit fell within the acceptable threshold in exploratory studies. Descriptive statistics, specifically mean and standard deviation were used to describe the data. Factor analysis was used to reduce the measurement items while pearson correlation was used to test the relationships between items.

DISCUSSION OF FINDINGS

A total of seven observation schedules were completed in each of the catering units. Cronbach's alpha was used to test reliability of indicators of environmental condition measurement items of which a value of 0.603 was obtained hence the indicators used were reliable in explaining environmental conditions of kitchens because according to Hair *et al.,* (2005) the general agreed upon lower limit for Cronbach's Alpha is =>0.70 but may decrease to =>0.60 in exploratory research. This study was exploratory hence attained the acceptable threshold of 0.6.

Descriptive Statistics

Table 1 shows the frequencies, mean and standard deviation for all the observations on a dichotomous scale of "yes or no". From the table, the highest mean value of 1.7143 (2 units out of 7) was attained in equipment being well placed, access to kitchen well located, cleanable surface areas, availability of hot water, provision of sinks for clean up and food preparation, chemicals not kept in the kitchen and disposable bags lined in waste bins. This was followed by mean of 1.571. (3 units out of 7) which indicated that most kitchens were fitted with a hood, had surface areas provided for different food items, adequate kitchen space and shelves provided. There was also means of 1.428 (4 units out of 7) which showed that some kitchen floors were slippery, pests are controlled by fumigation, there is good and adequate circulation of air and availability of waste disposal bins. Mean of 1.285 (5 units out of 7) showed the type of floor material was easily cleaned, had smooth walls with no cracks, natural lighting is adequate, ventilation is good, cold storage is provided, storage of vegetables and dry foods are separate, waste disposal bins are covered, drainage is good, temperature in the kitchen is good and there was adequate and clean water supplied to the kitchens. From these findings, it is evident that there are differing operating standards and that some units may not be adhering to laid down procedures owing to the fact that all the units are under one institution but seem to have different conditions. Kurtosis results showed that statistic (.840 – 2.800 and std error of 1.587) while Skewness statistic (.374 - 1.230 and std error of .794).

Table 1. Item Statistics

Items	Yes	No	N	Mean	Std. Dev
Equipment is well placed in the kitchen	2	5	7	1.7143	.48795
Access to the kitchen is well located	2	5	7	1.7143	.48795
Surface areas are cleanable	2	5	7	1.7143	.48795
Hot water is available for use throughout	2	5	7	1.7143	.48795
Sinks are provided separately for clean up & food preparation	2	5	7	1.7143	.48795
Chemicals are not kept in the kitchen	2	5	7	1.7143	.48795
Disposable bags are lined in the waste disposal bins	2	5	7	1.7143	.48795
A hood is fitted to extract smoke	3	4	7	1.5714	.53452
Surface areas for different food items have been provided	3	4	7	1.5714	.53452
Kitchen space allows free movement of people and equipment	3	4	7	1.5714	.53452
Shelves are available for storage	3	4	7	1.5714	.53452
Floor of the kitchen is not slippery even when water pours	4	3	7	1.4286	.53452
Pests are controlled by fumigation	4	3	7	1.4286	.53452
Circulation of air is good and adequate	4	3	7	1.4286	.53452
Waste disposable bins are available and accessible	4	3	7	1.4286	.53452
Type of floor material used is easily cleaned	5	2	7	1.2857	.48795
Walls are smooth with no cracks hence easy to	5	2	7	1.2857	.48795

clean					
Natural lighting is adequate in the kitchen	5	2	7	1.2857	.48795
Ventilation in the kitchen is good	5	2	7	1.2857	.48795
Cold storage and refrigeration is provided	5	2	7	1.2857	.48795
Storage of vegetables and dry goods are separate	5	2	7	1.2857	.48795
Waste disposal bins are well covered	5	2	7	1.2857	.48795
Drainage is good	5	2	7	1.2857	.48795
Temperature is good and comfortable for working	5	2	7	1.2857	.48795
Water supplied to the kitchen is clean and adequate for all use	5	2	7	1.2857	.48795

Exploratory Factor Analysis

Exploratory factor analysis was used to reduce measurement items for environmental conditions of catering units. KMO measure of sampling accuracy of 0.634 was found, which is within the acceptable minimum 0.5 measure of sampling accuracy. Kaiser, (1974) recommends values greater than 0.5 as acceptable. Bartlett's Test of Sphericity yielded a value of 1083.612 at a significance level of 0.000 which implied that the adequacy test of correlation matrix and the findings were satisfactory for the study. As shown on table 2, eigenvalues were obtained after the indicators for environmental conditions were analyzed. Using the criteria of picking those indicators whose eigenvalues are greater than one, only six components were obtained. Physical aspects was 32.67%, Fittings Made was 16.59%, Arrangement aspects 16.55%, Atmosphere 11.74%, Provisions considered 11.54%, and Cleaning aspects 10.87%. The six components cumulatively had a variance of 100%. This means that the indicators measuring environmental condition items could be adequately represented by six variables. In addition, reliability test conducted on the six components showed that all the components attained the acceptable level of 0.7 with the lowest being .652 and the highest being .696.

Table 2. Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings			
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Cronbach Alpha
1. Physical Aspects	10.400	41.600	41.600	8.170	32.678	32.678	.679
2. Fittings Made	4.978	19.912	61.512	4.150	16.599	49.277	.658
3. Arrangement aspects	3.810	15.241	76.753	4.139	16.556	65.834	.696
4. Atmosphere	2.623	10.493	87.246	2.937	11.749	77.582	.661
5. Provisions Considered	1.946	7.784	95.030	2.886	11.544	89.127	.652
6. Cleanliness Aspects	1.242	4.970	100.000	2.718	10.873	100.000	.683

Extraction Method: Principal Component Analysis.

As shown on Table 3, a rotated component matrix has six factors after Varimax rotation method with Kaiser Normalization was carried out. The six components explain the variables on environmental condition items after the principal component analysis was done. The rotation converged in six iterations.

Table 3. Rotated Component Matrix[a]

	Component					
	1 PHY	2 FIT	3 ARR	4 ATM	5 PRO	6 CLE
Waste disposal bins are well covered	.968					
Cold storage and refrigeration is provided	.968					
Water supplied to the kitchen is clean & adequate for all use	.968					
Temperature is good and comfortable for working	.968					
Surface areas are cleanable	-.968					
Ventilation in the kitchen is good	.968					
Pests are controlled by fumigation	.617					
Kitchen space allows free movement of people & equipment	-.617					
Floor of the kitchen is not slippery even when water pours						
A hood is fitted to extract smoke		-.931				
Equipment is well placed in the kitchen		-.903				
Walls are smooth with no cracks hence easy to clean		.903				
Storage of vegetables and dry goods are separate						
Surface areas for different food items have been provided			.849			
Shelves are available for storage			.849			
Chemicals are not kept in the kitchen			.825			
Natural lighting is adequate in the kitchen			.619			
Type of floor material used is easily cleaned				.891		
Circulation of air is good and adequate				-.825		
Disposable bags are lined in the waste disposal bins						
Hot water is available for use throughout					.962	
Access to the kitchen is well located					.962	
Waste disposable bins are available and accessible						.921
Drainage is good						.895
Sinks are provided separately for clean up & food preparation						-.620

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.

Pearson Correlation

Table 4 shows the correlation between the six components that measured environmental conditions and also the significance of the associations are shown. The total number of units under study were seven which emanated from seven units where data was collected using a non-participant observation schedule.

Table 4. Correlations of Components of Environmental Conditions of Food Preparation

		PA	FM	AA	A	PC	CA
Physical aspects	Pearson Correlation	1	-.192	.524	-1.000**	-.300	.493
	Sig. (2-tailed)		.680	.227	.000	.513	.261
	N	7	7	7	7	7	7
Fittings Made	Pearson Correlation	-.192	1	-.182	.192	.192	-.318
	Sig. (2-tailed)	.680		.696	.680	.680	.487
	N	7	7	7	7	7	7
Arrangement aspects	Pearson Correlation	.524	-.182	1	-.524	-.033	.255
	Sig. (2-tailed)	.227	.696		.227	.943	.582
	N	7	7	7	7	7	7
Atmosphere	Pearson Correlation	-1.000**	.192	-.524	1	.300	-.493
	Sig. (2-tailed)	.000	.680	.227		.513	.261
	N	7	7	7	7	7	7
Provisions Considered	Pearson Correlation	-.300	.192	-.033	.300	1	-.493
	Sig. (2-tailed)	.513	.680	.943	.513		.261
	N	7	7	7	7	7	7
Cleanliness aspects	Pearson Correlation	.493	-.318	.255	-.493	-.493	1
	Sig. (2-tailed)	.261	.487	.582	.261	.261	
	N	7	7	7	7	7	7

**. Correlation is significant at the 0.01 level (2-tailed).

Key: PA- Physical Aspects; FM - Fittings Made; AA - Arrangement Aspects; A – Atmosphere; PC - Provisions Considered; CA - Cleanliness Aspects

Relationships Tested

Table 5 presents a summary of the relationships tested that include physical aspects and fittings had a insignificant (r<.3) weak negative relationship (-.182: .680), physical and arrangement was insignificant (r>.5) with a strong positive relationship (.524: .227), physical and atmosphere was statistically significant (r=-1) with a perfect negative relationship (-1.000; .000), physical and provisions was insignificant (r<.3) with a weak negative relationship (-.300; .513), physical and cleanliness was insignificant with r<.5 and moderate positive relationship (.493; .261), fitting and arrangement was insignificant (r<.3) with a weak negative relationship (-.182; .696), fittings and atmosphere was insignificant (r<.3) with a weak positive relationship (.192; .680), fitting and provisions was insignificant (r<.3) with a weak positive relationship (.192; .680), fitting and cleanliness was insignificant (r<.5) with a moderate negative relationship (-.318; .487), arrangement and atmosphere was insignificant (r>.5) with a strong negative relationship (-.524; .227), arrangement and provisions was insignificant (r=0) with no linear relationship (-.033; .943), arrangement and cleanliness was insignificant (r<.3) with a weak positive relationship (.255; .582), atmosphere and provisions was insignificant (r<.3) with a weak positive relationship (.300;

.513), atmosphere and cleanliness was insignificant (r<.5) with a moderate negative relationship (-.493; .261) and finally provision and cleanliness was insignificant (r<.5) with a moderate negative relationship (-.493; .261). It can therefore be concluded that out of all the relationships tested, physical aspects and atmosphere was statistically significant, arrangement and provisions though insignificant had no linear relationship while all the other relationships were insignificant.

Table 5. Correlation Results

	Pearson Correlation	Sig. (2 tailed)	N	Strength of Association	Relationship	Statistically
Physical and Fittings	-.192	.680	7	0.1 < .3	Weak negative	Not significant
Physical and Arrangement	.524	.227	7	> .5	Strong positive	Not significant
Physical and Atmosphere	-1.000	.000	7	r = -1	Perfect negative	Significant
Physical and Provisions	-.300	.513	7	0.1 < .3	Weak negative	Not significant
Physical and Cleanliness	.493	.261	7	.3 < .5	Moderate positive	Not significant
Fittings and Arrangement	-.182	.696	7	0.1 < .3	Weak negative	Not significant
Fittings and Atmosphere	.192	.680	7	0.1 < .3	Weak positive	Not significant
Fittings and Provisions	.192	.680	7	0.1 < .3	Weak positive	Not significant
Fittings and Cleanliness	-.318	.487	7	.3 < .5	Moderate negative	Not significant
Arrangement and Atmosphere	-.524	.227	7	r > .5	Strong negative	Not significant
Arrangement and Provisions	-.033	.943	7		No linear	Not significant
Arrangement and Cleanliness	.255	.582	7	0.1 < .3	Weak positive	Not significant
Atmosphere and Provisions	.300	.513	7	0.1 < .3	Weak positive	Not significant
Atmosphere and Cleanliness	-.493	.261	7	.3 < .5	Moderate negative	Not significant
Provisions and Cleanliness	-.493	.261	7	.3 < .5	Moderate negative	Not significant

CONCLUSION

This study assessed twenty five environmental conditions in food preparation areas in Moi University. Using factor analysis, six components were extracted from the twenty five environmental conditions studied. The six extracted include physical aspects, fittings made, arrangement aspects, atmosphere, provisions considered and cleanliness aspects. The first component was named physical aspects which comprises of waste disposal bins covered, cold and refrigerated storage provided, good temperature, cleanable surface areas, good ventilation, pest control and adequate kitchen space. Second component was fittings made comprising of a hood in the kitchen, well placed equipment and smooth walls with no cracks. Third component was arrangement aspects which include having surface areas for different food items, shelves for storage, absence of chemicals in the kitchen and having natural lighting in the kitchen. Fourth component was named atmosphere which includes having a floor that is easily cleaned and good circulation of air in the kitchen.

Fifth component was provisions considered that include having hot water available in the kitchen and well located access to the kitchen. The last component was cleanliness aspects which include availability and accessibility of waste disposal bins, good drainage and having separate sinks for clean up and food preparation. From the components extracted, the study recommends that management of catering units should endeavour to consider these components as a guide when setting up kitchens.

Based on the components extracted and results of Pearson correlation tests, the relationship between physical aspects and atmosphere was significant while all the others were not significant. This finding could mean that physical aspects such as ventilation, temperature and space have high impact on the circulation of good air which is an element of atmosphere component. Moreover, it was also in the relationship between physical aspects and atmosphere that had a perfect negative relationship whereas all the rest of the relationships were weak, moderate or strong apart from arrangement and cleanliness that had no linear relationship.

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