

Comparative Analysis of Food Safety System of Food Laboratories of A State University

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ABSTRACT

The study focused on the comparative analysis of the food laboratories of three campuses a State University. Food safety audits using Sanitation Standard Operating Procedure (SSOP) and current Good Manufacturing Procedures (cGMP) were instruments in evaluating the laboratories. Conformances were determined except on maintenance on hand washing and sanitizing facilities on SSOP categories and on warehouse and distribution of cGMP Guidelines . Comparative analysis on the conformances using Kruskal Wallis Analysis revealed significant difference only on the process and control of cGMP guidelines. To comply with the requirements of the SSOP and cGMP, it was recommended that food safety manual be developed, the improvement of plumbing system, coving, non-slip flooring, and provision of facilities like hand washing, screens of doors and windows, locker room; wearing of chef uniform only inside the laboratory; monthly water analyses; and provision of regular seminar for food safety trends, as well as procedural instructions for equipment were likewise recommended.

Keywords: Food safety, cGMP , SSOP, food safety system, food safety audit

1. INTRODUCTION

The food service industry is one of the indispensable business that finds competitions to capture customers. Its market does not just look for a delightful food, but more importantly checks on how hygienic and how safe the food to be served. It is not only the food industry's social responsibility but also the government's responsibility to ensure that the food to be served is safe and free from hazards. As such policies that support safety on food processing/production have been established. Among these are the Republic Act No. 10611 referring to Food safety Act of 2013, which articulate principal responsibility, general principles, objectives, crisis management and implementation of regulations, fees and even sanctions of government agencies (Official Gazette, 2013); Presidential Degree (PD) 856 also known as the Implementing Rules and Regulations of Food Establishments of the Code of Sanitation of the Philippines which formulated guidelines to ensure that customers are protected. One of these is the Administrative Order No. 153 s. 2004 which is the Revised Guidelines on current Good Manufacturing Practice (cGMP) in manufacturing, packing, repacking or holding food. From Administrative Order No. 208 s 1974, it

was revised and improved to align cGMP for human food with international standards of cGMP. In addition, it was improved to allow for consistency in industry implementation and regulatory inspection by FDA regulators^[15].

Food handlers are the implementers when it comes to food safety. Aside from maintaining an environment that will support food safety, they control the operation to ensure that the food to be served is safe. To ensure personnel are well trained and adhere to food safety standards, from the early start on their training in school, it is an advantage if they are trained in an environment where food safety practices are actually observed in their cooking activities in food laboratories. A good training background of the students may help the food industries to maintain their objective of serving safe, wholesome and good quality food.

The State University covered in this study supports the need of future food handlers by providing them facilities that will expose them on the industrial setup. Three major campuses of this university that provide facilities and offer courses that help food

handlers enhance their capability in preparing safe food served as research environment. The university provides facilities that will expose students on industrial setup. This study wanted to look into the food safety system in the respective food students learn basic cookery are trained on how to apply the principles of food safety in all activities at the food laboratory/ kitchen. This training ground will also make students aware of importance food safety which may become part of their food safety ethics. Thus, it becomes a routinary practice to have all their prepared/process food are free of hazard.

Objectives of the Study

The study aimed to compare the conformance of the three selected campuses based on the SSOP categories and cGMP guidelines.

Specifically, it aimed to attain the following objectives:

1. To determine the conformance of the food laboratories in the following Sanitation Standard Operating Procedure (SSOP) categories:
 - 1.1 safety of water supply
 - 1.2 cleanliness and condition of food contact surfaces
 - 1.3 prevention of cross contamination
 - 1.4 maintenance of hand washing and sanitizing facilities
 - 1.5 protection of packaging and FCS from adulteration
 - 1.6 labelling, storage and use of toxic compounds
 - 1.7 control of employee health and condition
 - 1.8 exclusion of pest
 - 1.9 monitoring of Cleaning, Sanitation Programs and Personnel Hygiene
 - 1.10 glass, Hard Plastic and Wood Control
2. To determine the conformance of the food laboratory in the following current Good Manufacturing Practices (cGMP) guidelines.
 - 2.1 personnel
 - 2.2 education and training
 - 2.3 plant and grounds
 - 2.4 plant construction and design
 - 2.5 sanitary facilities and control
 - 2.6 equipment and utensils
 - 2.7 process and control

3. To compare the conformances of the food laboratories of the three campuses to SSOP and cGMP.

2. MATERIALS AND METHODS

The study involved the evaluation of conformance of food laboratories of the three selected campuses of a State University focusing particularly on cGMP and SSOP categories and guidelines. Students and instructors utilizing the food laboratories were sources of data in this food survey audit complemented by the interview of the in-charge instructor. To ensure the validity of the audit, the researchers conducted the audit on the pre-operation, operation and post operation food laboratory activities. For more accurate data, the most populated class was selected as subjects of the study.

The researchers' constructed checklist was aligned on the standard checklist used for cGMP and SSOP audit. Prior to its development, the standard audit checklist for cGMP was excerpted from Administrative Order 153 which is the standard guide on audit checklist. The modified checklist was presented to Food Safety System experts for suggestions, recommendations, and other comments on content and structure.

Conformance of the three campuses was compared by testing the null hypothesis using non-parametric test, Kruskal Wallis, with each category as the variables. Non-conformances of the three campuses were determined recognizing what particular category or guideline need to be improved.

3. RESULTS AND DISCUSSION

Conformance to SSOP Guidelines

Table 1 shows the summary of the conformances of the three campuses on SSOP categories.

Table 1. Summary Data of the Conformances and Percentages of the three campuses SSOP categories

SSOP Categories	No. of Criteria	Conformance					
		Campus A		Campus B		Campus C	
			%		%		%
Safety of water	3	1	33	1	33	1	33
Cleanliness and condition of FCS	8	5	63	5	63	6	75
Prevention of Cross Contamination	4	0	0	0	0	0	0
Maintenance of Hand Washing and sanitizing facilities	3	-	-	-	-	-	-
Protection of packaging and FCS from adulteration	2	0	0	0	0	0	0
Labelling, storage and use of toxic compounds	2	0	0	1	50	1	50
Control of employee health and condition	2	2	100	2	100	2	100
Exclusion of pest	4	3	75	3	75	3	75

1.1 Safety of water

On checking the safety of water, the clearness and absence of debris, presence and concentration of chlorine should be checked before, during and after the operation. The three evaluated campuses had the same conformance of 33%. Their waters were assessed to be clear and free from debris. Legally, as stated in AO No. 2007-0012 – Philippine National Standard for Drinking Water for 2007, the frequency of sampling for physical and chemical analysis of an institution such as classified as level III which serves a population of greater than 600 but less than 5000, should be conducted at least once a year whereas the microbiological examination should be done at least monthly. Campus A conducted its annual microbiological and chemical analysis of water on December 2015, in compliance its planned programs and activities for a wholesome, safe and healthy environment. Campus B conducted its annual microbiological, physical and chemical analysis on October 2015, whereas Campus C had their two analyses held on October 2014. Campus A complied with the required parameters though water samples were taken from fountain and the clinic faucet only and not directly in the food laboratory. Campus B

likewise complied with the physical and chemical analysis but its microbiological examination was not done monthly. According to the PNS of Drinking Safe Water, classifying these campuses as level III, examination should be conducted at least monthly to ensure safety of water, since microbial contamination of the water is more critical when it comes to foodborne illness. Campus C failed to update its laboratory analyses for 2015 due to budget constraints. Outsourcing to another private laboratory will require expensive analyses.

1.2 Cleanliness and condition of food contact surfaces

In this category of equipment and facilities condition, the cleaning and sanitizing procedure, the students' outer garment condition and the sanitizer concentration were monitored before, during and after the operation. For Campus A, all equipment were in good condition except its cooling storage/chillier and convection oven. As noted, written documented cleaning procedure on facilities like cooling storage and how often these would be done were not observed. However, the students' outer garments like chef uniform, apron, shoes and head cap were noted to be clean and in good condition. Campus B's cooling storage was new and not yet utilized as the equipment needed a voltage regulator. Utilizing the equipment would cause fluctuation of power supply in the building. Equipment and facilities were cleaned but sanitizing process was not noted. As with campus A, there were no written documents on the frequency and procedure for cleaning and sanitizing materials. Outer garments of the students were noted to be clean and in good condition. Lastly, on Campus C, the percent of conformance was 75%. Equipment and facilities were noted to be in good condition but like Campus A and B, the campus had no documented or written procedure for cleaning and sanitizing process. Cleaning was observed but sanitizing throughout the process as not seen. Outer garments of the students were clean and in good condition.

1.3 Prevention of cross contamination

To prevent cross contamination, sanitation standard operating procedure requires monitoring whether all food handlers wear complete attire, wash their hands before working with food and as necessary during processing of food and if all equipment and

utensils are cleaned and sanitized before use and placed in their designated assigned area. The campuses did not comply these requirements. Their students were observed not wearing complete uniform. In Campus A, there were few students who did not wear head cap, some did not have an apron, women wore sandals and men wore rubber shoes. In campus B, some students had earrings, and not all students inside the laboratory wore a head cap. There was a student observed to have nail polish while performing food preparations. Similarly in Campus C, not all students wore complete uniform, some did not have head cap and apron, and a student had nail polish while doing the dish washing. In A and B campuses, a standard footwear was not required strictly as long as they wore closed shoes to ensure safety of the student. However, black closed shoes are a requirement while in the laboratory. Cleaning and sanitizing of equipment and facilities before use, was not strictly followed. The utensils were not cleaned all of the time prior to use and sanitizing was not practiced after the cleaning. The equipment and utensils were placed on their designated area after use.

1.4 Maintenance of handwashing and sanitizing facilities

In monitoring the condition of the hand washing and sanitizing facility, its adequate supply and correct concentration should be checked before, during and after the production/laboratory. The evaluation of the three campuses on this category noted NA (not applicable) since hand washing and sanitizing facilities were not available in all of the laboratories even in comfort rooms. Aside from these, knowing the absence of the particular facilities, a dispenser of either hand washer or sanitizer was not observed on their sink. In addition, procedure on how to properly hand wash was not displayed either on the laboratory or in the designated comfort rooms. This infers that the students utilizing the laboratory were made mindful on the importance of hand washing when it comes to safety of their food to be prepared. The Food and Drug Administration (FDA) recommends cleaning hands of the employees in a hand washing sink or approved automatic hand washing facility. It does not recommend cleaning hands in a sink used for food preparation or warewashing or service sink or a curbed cleaning facility used for disposal of liquid waste and water mop. As a food laboratory, utmost importance to hand washing should be given much attention. According to McSwane^[7], hand

washing is one of the six elements of food safety; indicating that to be able to attain safety of food prepared, frequent hand washing is advised. This would further prevent the occurrence of cross contamination coming from the unsanitized hands. Gerodias^[13] added that in relation to poor personal hygiene, food handlers failure to wash their hands before proceeding to work may pose a great threat to food safety.

1.5 Protection of food, food packaging and food contact surfaces from adulterants

In this category, food grade chemicals should be separated from non-food grade chemicals, stored outside the food laboratory and all additives should be separate from other ingredients and raw materials. Both Campuses A and B had 0% compliance meaning they failed to separate the food grade to non-food grade chemicals and stored outside the processing area. Both had no designated area outside the laboratory where the non-food grade chemicals should be stored. Campus A had chemicals placed on sink or some under the sink. As dispenser for dishwashing liquid, bottled waters with no labels were used making them open for adulteration. Of the three campuses, Campus C complied with the requirements. There was a designated stock room for non-food grade chemicals; separation of additives to other raw material was not evaluated as no additives were stored in the laboratory. As cited in the Code of Federal Regulation (CFR), the design, construction and use of equipment and utensils shall run-up the adulteration of food with non-food grade lubricants, fuel, metal fragment, contaminated water or any other contaminants. The food contact surface should be corrosion resistant, made from non-toxic material, designed to withstand the environment of its intended use and actions of food and the cleaning and sanitizing agent is applicable. Mcswane^[7] suggested that the food contact surface, if possible, should be made of stainless steel.

1.6 Labelling, storage and use of toxic compounds

In this category, toxic compounds used in the food laboratory were evaluated if they were properly labelled, and if there were available instructions and recommended storage. Campus A got 0% compliance on this category indicating toxic compounds used in their laboratory were not properly labelled. It was

out that dishwashing liquids used in the sink were diluted on empty drinking bottle and not properly labelled. Also documented instruction and recommended storage were not available. Campus B had 50% compliance on this category. The only chemicals observed in the laboratory were the dishwashing liquid and dishwashing paste. These were diluted and dispensed in a dishwashing liquid bottle and easily identified as soap. Like in Campus A, no available instructions and recommended storage were available in the laboratory. In Campus C, chemicals were distinct and properly labelled even the food (used for demonstration) were all properly labelled. However, instructions and recommendations for emergency cases were not available in the laboratory, thus given a 50% conformance rating.

1.7 Control of employee health and condition

To audit this category, food handlers were evaluated if they were fit to work and had no signs of medical problems. All the three campuses got 100% on this category. This was because food handlers/students were medically assessed first prior to enrolment; and during the laboratory observation. No signs of medical problem were observed among the students.

Codex Alimentarius Commission (CAC) recommends control of the health condition of all food handlers in the food establishments, and establishments of reasonable measures to prevent microbial contamination of food, its packaging and food contact surfaces considering the food handlers are a potent source of cross contamination. CAC added that ill, or carrier of disease or illness should not be allowed to enter the working areas if they are likely to contaminate the food. Medical examination is recommended to the food handler if clinically indicated.

CFR advised that plant management should ensure that its personnel is free from disease like open lesions, boils, or infected wounds that may cause microbial contamination. In case of illness, personnel is instructed to report to supervisors.

1.8 Exclusion of pest

To evaluate this category, the condition of the building is checked. The ground should be free from litter and improperly stored equipment and materials

and uncut weeds. Food handlers are checked if they follow good hygienic practices and; if the cleaning and sanitation plans are strictly followed and implemented. All three campuses had 75% compliance on the evaluation for exclusion of pest. The buildings were new and in good repair/condition. The grounds the area were and weeds were cut. There were no improperly stored equipment and materials. Their food handlers followed good hygienic practices but campuses A and B had no documented cleaning and sanitation plans to be strictly followed and implemented. In the case of Campus A laboratory cleaning was done at end of semester initiated by the student organization and utility personnel. In case of Campus C, cleaning was done through their program Brigada Hostel documented in 2015. Though it could be should the campuses conducted laboratory cleaning, this was not documented possibly due to lack of cleaning and sanitary plans.

1.9 Monitoring of cleaning, sanitation programs and personnel hygiene

To evaluate on this category, the laboratory should have no visible dirt, even when tissue is rubbed on the surface and smells clean, no place has foul odor. The attire of the students/food handlers should be clean. In Campus A, the equipment like oven and stainless table were dusty, however the student's attire was clean. Campus B, cobwebs were observed, the laboratory had a fouling odor and had the floor markings indicating the place was not cleaned properly. Students' attire was clean but not all students wore proper uniform. The laboratory of Campus C was observed to be clean with no unpleasant or fouling odor during the audit. The attires of the students were clean. Campus C which had the least class utilizing the laboratory was able to comply on the monitoring of the cleaning and sanitizing program. Campus A which had maximized utilization of the laboratory failed the most in complying to the monitoring of the cleaning and sanitizing program. Conclusively hectic schedule and heavy use of the laboratory were contributory factors to weak compliance to cleaning and sanitizing requirements.

1.10 Glass, hard plastic and wood control

In this category, all glass materials were checked if these were in good condition and properly intact; all hard plastic material and equipment were be repaired and in good condition. The three campuses got 100%

All glass materials, hard plastic material and utilized equipment were all repaired and in good condition ; no broken glass nor worn out hard plastic material and defective equipment were utilized while processing food material.

2. Conformance of CGMP Guidelines

Table 2 shows the summary information on the conformances of three campuses on cGMP Guidelines.

Table 2. Summary of Conformances and Percentages of three different campuses of BatStateU according to cGMP guidelines

cGMP Guidelines	No. of Criteria	Total Number of Conformances and Their Percentages					
		Campus A		Campus B		Campus C	
			%		%		%
Personnel	14	7	50	6	43	10	71
Education and Training	3	1	33	1	33	1	33
Plant and Grounds	10	6	60	7	70	8	80
Plant Construction and Design	20	7	35	8	40	13	65
Sanitary facilities and control	13	0	0	0	0	1	8
Equipment and Utensils	5	4	80	4	80	4	80
Process and Control	10	1	10	1	10	9	90
Warehouse and distribution	-	-	-	-	-	-	-

2.1 Personnel

This guideline on personnel evaluates the health condition while working, the outfit or clothing while inside the laboratory and the cleanliness and practices of personnel inside the food laboratory. Of the three campuses, Campus C had the highest conformance. However personnel and laboratory users in the three campuses were aware on how to control disease like respiratory tract infections, intestinal disorder and skin disorders. Initially, the university has as requirement, a physical examination like x-ray evaluation prior to enrolment to ensure faculty/staff and students are in good health. As noted, the university students wore their chef uniform upon entering school premises and

used the recommended apron once the laboratory class started. Although toque and hairnet are recommended, not all of the students wore them. Facial mask and gloves are also recommended but during the conducted audit, students from the three campuses did not use mask and gloves even on processing cooked or ready to eat food. While jewelries are not allowed inside the kitchen, there were students observed wearing series of earring and wrist baller. It was observed that students were not particular on handwashing practices before commencing to laboratory work, and even during processing of food products. It was also observed no handwashing instructions were visible in lavatory and toilet facilities.

2.2 Education and training

The three campuses had 33% only on their conformance to the guidelines on education and training. Although proper orientation regarding safety and sanitation was given before the start of semestral laboratory activity, no update seminar like current trends on food safety trends was given in all campuses. AO 153 mandates the conduct of continued food safety training in adequate frequency to ensure that workers remain familiar and updated with the trends of food safety. Students may also have update knowledge from their classes.

2.3 Plants and Grounds

As required the plant, or the food laboratory should be equipped with adequate sanitary facilities to ensure maintenance of environmental hygiene. Proper waste disposal, proper design and construction and ground condition were also evaluated on this guideline. Generally, grounds or the environmental hygiene of the food laboratories were considered acceptable. The laboratories in the three campuses were not prone to flooding, far from environmental polluted area, not located on excessively dusty road or parking lot that may constitute a source of contamination in areas where food is exposed. Waste disposals should be regularly cleaned. Campus A had 60% compliance in this category. It was observed its waste disposal containers were not properly covered and regularly cleaned in between uses.

Its laboratory layout did not allow optimize process flow and there was no sufficient space for all laboratory activities. Occupied by six groups in a class

with at most seven members, laboratory only had two functioning sinks to accommodate all the students. Also, ovens were found malfunctioning.

Campus B had 70% conformance. Similarly its food laboratory layout did not optimize the food process flow; there was allotted space for electrically run equipment. The students had to prepare directly on the floor to process osterizing or blending instead on working on a separate working table which was near to the area where all the bags were stocked. Conformance of campus C was 80%. Its food laboratory allowed the mix up of the food process flow and the preparation table was used also for assembly of the finished product. There was insufficient space for all activities in each particular laboratories. Oven for baking was in the hot kitchen.

2.4 Plant construction and design

The laboratory buildings and structures were checked if they facilitated and maintained sanitary operation for food processing purposes and if they were repaired. Sufficient area for each part of the food flow as well as spacing for placement and operation of equipment and storage of raw material and finished products was also audited. Separation of food-grade to non-food grade products as well as the designation of washing area for specific utensils, trays, containers and similar equipment is of importance to prevent cross contamination and adulteration. It was noted the construction and design of the structures of floors, walls, and ceiling, adequate lighting and ventilation and screenings of openings like windows and door of the two food laboratories did not facilitate maintenance and sanitary operation for food processing purposes.

2.5 Sanitary Facilities and Control

Only Campus C has designated a separate room for non-food grade products. It was noted also that the three campuses did not have sufficient supply of chemicals for cleaning and maintaining the sanitary operation of the food laboratory.

The design of the sinks did not comply with the sanitary requirements. It was mentioned that not all of the sinks functioned due to frequent clogging of their drainage. The faculty in-charged in one campus said that the diameter of the plumbing of the sink was not

enough to support the water draining causing overflow. Also, grease traps were not properly designed thus keeps stagnant water in the sinks; food materials could also not be trapped. On the other hand, one populated campus had only two small sinks use of 40 students with no grease trap to drain the food materials.

2.6 Equipment and utensils

On this guideline, equipment and utensils directly utilized for food processing should be designed and constructed using materials that are easily and adequately cleanable and maintained; They should not have glass parts unless shatterproof, are made from stainless steel and not from wood. Food contact surfaces are smooth, continuous, and without rough spots cracks or crevices; and all corners of the floor connecting the wall should be rounded or coved. The three campuses had 80% compliance with meeting (our out of five guidelines).

The only flaw observed was the absence of coving or all corners of the floor connecting the wall were not rounded. Absence of coving on corners of the laboratory causes build-up of dirt in corners.

2.7 Process and control

The audit only included evaluation of stocking of raw material on the laboratory prior to consumption. Campus A and Campus B stored/placed raw materials directly on the floor whereas Campus C was not seen practicing this during the assessment. First-in, first-out stock rotation practice was not evaluated since stocking was not practiced. Receiving record inventories and record keeping of all incoming raw materials were not seen in the three campuses.

3. Comparison of Laboratory Conformances of Three Campuses

SSOP Categories

No significant difference was noted on the conformance of the three campuses on the SSOP categories as evidenced in the p-values computed using

Kruskal-Wallis test. This implies that there is no significant difference on the percent conformance of the three campuses on the SSOP categories.

cGMP Guidelines

Table 3. Comparison on the Conformances of the Selected Food Laboratories of BatStateU on Current Good Manufacturing Practices (cGMP)

Variables	p-values	Computed value	Decision on Ho	Verbal Interpretation
1. Personnel	0.29	2.50	Failed to Reject	Not Significant
2. Education and training	0.99	0.000	Failed to Reject	Not Significant
3. Plants and grounds	0.86	.30	Failed to Reject	Not Significant
4. Laboratory and construction	0.32	2.26	Failed to Reject	Not Significant
5. Sanitary facilities and control	0.99	0.000	Failed to Reject	Not Significant
6. Equipment and facilities	0.99	0.000	Failed to Reject	Not Significant
7. Process and control	0.004	11.0	Reject	Significant
8. Warehouse and distribution	-	-	-	-

Based on the conformance to cGMP guidelines, significance difference on the assessment was noted on process control with a p-value of 0.004 which is less than 0.05. This means that there is significant difference on percent conformance of the three campuses on the cGMP guidelines particularly on process and control. The difference on percent conformance could be due to the observed different strategies of each facilitator/instructor. All the other aspects of cGMP guidelines had p-values ranging from 0.29 to 0.99 which are greater than 0.05. These indicate that no significant difference on the assessments on conformance to these guidelines. Common observations and findings were noted like absence of screening of windows and doors, no coving on flooring and inadequate designing of plumbing causing clogging of pipings, absence of handwashing and sanitizing facilities. Also, common compliance were noted also on provision of

smooth, easily cleanable food contact surfaces like stainless table tops.

4. CONCLUSIONS

Based on the results of the food safety audit, the following conclusions are drawn:

1. The food laboratories of the three campuses conform on all SSOP except on maintenance on hand washing and sanitizing facilities due to the absence of the mentioned facilities.
2. Most cGMP guidelines are conformed to their performance on laboratory except with warehouse and distribution since stocking/storage of raw materials and finished products are not done inside the laboratory.
3. There are no significant differences on the assessments on conformance of the food laboratories to SSOP criteria among the three campus. Similarly, there are also no significant differences on conformance of the laboratories of the three campuses to cGMP guidelines except on the guidelines on process and control.

5. RECOMMENDATIONS

The following recommendations are endorsed:

1. A food safety manual may be prepared to be followed to standardize the process and control in the food laboratory.
2. For the structure, design, layout and construction of the laboratory, the following recommendations are given:
 - a. Installation of adequate hand washing facilities should be inside the food laboratory
 - b. Sufficient and defined area for each process flow like assembly of finished goods should be provide
 - c. Adequate screening for doors and windows
 - d. Defined locker room for student's baggage and changing room/ dressing room
 - e. A sound design of plumbing with adequate capacity
 - f. Provision of shatterproof covering for lightings
 - g. Coving of flooring connecting the walls and non-slip flooring on the food laboratory
3. In relation to some protocols/ standard operating procedures inside the university, these recommendations are given:

- PNS of safe drinking water based on the population level of the university
- c. A regular seminar/ update for food safety trends is recommended.
4. Procedural instructions on how to operate and clean each equipment are recommended.

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