

CORRELATES OF FOOD SAFETY PRACTICES OF THE CHICHACORN INDUSTRY IN ILOCOS NORTE

Fairie Anne P. Acebedo*, Catherine P. Abadilla, Marilyn P. Domingo,
Buenaflora R. Asiao, and Zenaida H. Esteban

Abstract

The National Economic Development Authority-Development Bank of the Philippines-Mariano Marcos State University (NEDA-DBP-MMSU) Project (2007) survey revealed that not one of the Ilocos Norte food processors could approximate Good Manufacturing Practices (GMP), a basic food safety program required by the Bureau of Food and Drugs (BFAD). The Ilocos Norte chichacorn industry is not an exemption. Thus, this study determined the factors affecting the adoption and implementation of food safety program in the said industry.

Fourteen chichacorn owners and ten workers located in Paoay, Solsona, Pinili, and Dingras served as respondents of the study. Majority of the chichacorn establishments were categorized as micro enterprises based on the number of workers. Owners' production areas were mostly extension of their houses. Product processing was still based on accustomed production practices using minimal equipment available. Not all processors are registered with regulatory agencies as some operate without BFAD registration, which is a basic requirement of all food establishments based on P.D. 856 (Sanitation Code of the Philippines).

Moreover, owners and workers had a moderate knowledge level on food safety. However, their beliefs and work behavior on food safety practices were highly favorable. The environmental condition in their production plant though was moderately favorable. Meanwhile, their level of compliance with food safety practices during production was low.

The respondents' personal characteristics are significantly related to their work behavior, but not with their food safety practices. In contrast, respondents' knowledge belief and environmental condition are highly significant to their existing food safety practices. Additionally, the respondents are knowledgeable about some food safety practices, but the condition of their processing plants and the existing practices of the workers run counter to what they know and believe in.

Keywords: *food safety, chichacorn, industry*

**Corresponding Author:*

Current Address: MMSU-College of Industrial Technology, Laoag City;

e-mail: aces_fayr@yahoo.com or f.acebedo16@gmail.com

Introduction

Food safety has been gaining increased attention lately because of increasing cases of food-borne illnesses worldwide due to globalization, production efficiency techniques, and uncertainty surrounding existing and emerging food-borne risks, as well as the public interest in microbial food safety and dietary concerns.

According to the Food and Agriculture Organization-World Health Organization (FAO-WHO) Philippine report, some processors are faced with difficulties for food safety program compliance such as Good Manufacturing Practices (GMP) particularly small-and- medium-enterprise plants. This finding is parallel with the benchmark survey results conducted by Abadilla et al (2007) that none of the food processing establishments in Ilocos Norte would comply with GMP. The Ilocos Norte chichacorn industry is not an exemption.

The chichacorn industry in Ilocos Norte is one of the major food processors under the snacks category. It has been noted by the Department of Trade and Industry (DTI) as among the promising industries in the country as it has already penetrated foreign markets where there are Filipino communities such as those in Cyprus, Australia, and Saudi Arabia. In 2007, it had \$14,400 export sales, which is on top of the P14.005 million domestic sales (Valdez, 2007). However, despite the tremendous success of the industry, it was observed by Abadilla et al (2007) that none of the chichacorn producers in the province could approximate GMP standards, the basic food safety required by BFAD. Results of the same study showed that the Total Plate Counts (TPC) of the samples from the chichacorn

processors were from 1700 to 3600 cfu/g, which was higher than the maximum level of 10cfu/g. TPC manifests proper food safety implementation in the food processing sector (<http://foodoregonstate.edu.html>-accessed 08/22/2006).

According to the FAO-WHO country report of Ramos and Oblepias along with local and national studies conducted by Albano (2004), Nieto-Montenegro et. al. (2006), McArthur et.al (2006), Hine et. al., Altekruise et al (1995), Knabel (1995), Pradish (1999) and Wilcock et al (2003), many factors affect compliance in putting food safety programs in place. This trend is attributed to socio-economic factors, technical knowledge, behavioral change, as well as managers' and workers' values among others.

The absence of proper and effective food safety control causes production losses and public confidence in the food industry; thus, it is necessary to maintain the safety and quality of food being produced by the food industries. A comprehensive control procedure in the food chain should be in place to ensure safe and high quality foods. One of this control procedure is the GMP – the basic food safety program.

Considering that the chichacorn industry is a promising snack industry in Ilocos Norte, proper and effective food safety control should be in place. However, due to the absence of a study ensuring proper food safety practices and production of quality chichacorn, this study was undertaken. Generally, this inquiry documented the existing food safety practices of the chichacorn industry, and determined the factors related to the same in chichacorn processing.

Specifically, it identified the respondents' personal and business profile; their knowledge level on food safety practices; their beliefs and work behavior on food safety; the environmental condition of their processing plant; their chichacorn production safety practices; the relationship between food production safety practices followed in the chichacorn industry; and the relationship between the respondents' personal characteristics, knowledge, beliefs, work behavior, environmental condition of the processing plants, and their food safety practices.

Methodology

Locale of the study. Ilocos Norte is known for its agricultural crops such as garlic, onion, rice, corn, and other cash crops. Being a corn producer, the province is famous for its processed corn called chichacorn. This study was conducted in all towns of Ilocos Norte where chichacorn producers operate such as Paoay, Solsona, Pinili, and Dingras.

Research design. The study used a combination of descriptive and relationship research designs. The descriptive dimension focused on the respondents' personal and business profile. Meanwhile, the relationship aspect looked into the interplay between the respondents' personal and business profile, knowledge, beliefs, work behavior as well as their respective manufacturing plant's environmental condition and their food safety practices.

The 14 owner-and 10 worker-respondents came from the chichacorn producers in Paoay, Pinili, Dingras, and Solsona. The workers interviewed were those who have been involved in the

industry for at least one year and had knowledge on the entire production process. Complete enumeration of the manufacturers was considered because their size was manageable.

Interview instrument and administration. An interview schedule determined the respondents' personal and business profile, level of knowledge, beliefs, work behavior, environmental condition, and the existing food production safety practices.

Items were constructed based on the provisions of the CFR-Code of Federal Regulations Title 21 Part 110-Current Good Manufacturing Practice in Manufacturing, Packaging or Holding Human Food, PNS/BFAD 23:2010-Recommended Code of Practice of the Processing and Handling of Fried Corn Snacks (Chichacorn) and the observed manufacturers' processing practices.

Data sets on knowledge level, beliefs, and work behavior were gathered through an interview schedule. Follow up questions were asked to let the respondents elaborate their responses. Meanwhile, data on the environmental condition of the manufacturers were based on the researchers' observations.

Data analysis. Frequency counts, percentages, and means were used in analyzing the data. Using SPSS 14.0 by Windows 2005 (SPSS, Inc.), Pearson r correlation coefficient determined the relationship between the food safety practices and the respondents' personal characteristics, knowledge, attitude towards food safety practices, beliefs on food safety, and the environmental conditions in their chichacorn processing plants.

Levels of knowledge, beliefs, work behavior, and environmental conditions were determined using score ranges based on the number of items per parameter equally distributed in a three-descriptive level category.

The level of knowledge was determined using a 20-item true or false test. Means of the respondents' scores were computed, which were further categorized as follows: high (14-20), moderate (7-13), and low (0-6).

Beliefs, work behaviors, and environmental conditions were determined using a 15-item compliance checklist. Mean scores were computed and categorized into three: favorable (11-15), moderately favorable (6-10), and unfavorable (0-5).

Results and Discussion

Respondents' Personal and Business Profile

Table 1 shows the respondents' demographic and business profile such as age, gender, educational attainment, number of years in the business, and seminars or training programs.

Age. The highest frequency of respondents included those who belonged to the 46-60 range. This means that the chichacorn industry work force is generally middle aged.

Gender. A big majority (67%) of the respondents were females and they were primarily responsible in sorting corn kernels, washing boiled corn, and packaging. On the other hand, the males who comprised the rest of the

respondents did the drying, boiling, washing, frying, as well as storing raw and semi-processed and processed corn. These findings suggest that females dominate the work force and lighter tasks are done by them while heavier tasks are accomplished by the males.

Educational attainment. Almost all (96%) of the respondents had formal schooling, while one (4%) did not have. The respondents started and completed elementary (33%), high school (38%), college (4%) and vocational and graduate studies (4%). This trend means that the industry accommodates work force whose educational background cuts across all levels.

Number of years in the business. Half of the respondents had been working in the chichacorn industry for about ten years, while only a few (8%) had been in the business for at least 20 years.

Seminars/Training programs attended. The respondents attended seminars and training programs on current Good Manufacturing Practices (cGMP) (42%), food preparation (21%), sanitation (8%), and Hazard Analysis Critical Control Point (HACCP) (4%). However, almost one of three never had a chance to participate in any of the same activities.

Respondents' Knowledge on Food Safety

cGMP. A big majority of the respondents were knowledgeable on cGMP as a food safety program required by BFAD for food establishments, which is a joint concern of the government, the industry, and the consumers (Table 2a).

Table 1. Personal and business profile of the respondents (n=24).

PROFILE	FREQUENCY	PERCENTAGE
Age		
<30	6	25
31-45	5	21
46-60	8	33
>60	5	21
Mean	46	
Gender		
Female	16	67
Male	8	33
Educational Attainment		
Elementary	8	33
High School	9	38
Vocational	1	4
College	4	17
Graduate Studies	1	4
No Formal Education	1	4
No. of Years in the Business		
<10	12	50
11-20	10	42
>20	2	8
Mean	11	
Seminars/Training Programs Attended*		
Current Good Manufacturing Practices (cGMP)	10	42
Food Preparation	5	21
Sanitation	2	8
Hazard Analysis Critical Control Point (HACCP)	1	4
None	7	29

*Multiple Responses

Personal hygiene practices. The respondents were knowledgeable on personal hygiene practices such as wearing of apron (93%), washing of hands properly (71%), and assigning supervisors to ensure food safety compliance (58%). However, only about one-third of them (36%) knew that food handlers were major sources of food-borne diseases. In addition, they acknowledged that pests, mice, and

cockroaches are other sources of food-borne diseases.

Processing plant facility, design, and sanitation practices. Respondents were knowledgeable on the provision of properly-designed processing establishments and sanitation practices. These include proper storage of ingredients and equipment that could help prevent food from contamination that

Table 2a. Knowledge of the respondents on food safety.

FOOD SAFETY DIMENSION	KNOWLEDGEABLE		NOT KNOWLEDGEABLE	
	Freq.	%	Freq.	%
cGMP				
Food safety is the concern of the government, industry and consumers	18	75	6	25
cGMP is the basic food safety requirement of the BFAD	15	63	9	37
Personal Hygiene Practices				
Wearing of hairnet during production prevents contamination	23	93	1	7
Washing of hands in a dipper would cause microbial contamination	17	71	7	29
Assigning of supervisors is necessary to comply with food safety practices in the food processing plant	14	58	10	42
Considering food personnel as one major source of foodborne diseases	11	36	13	54
Processing Plant Facility, Design and Sanitation Practices				
Storing of Ingredients, food and chemicals in separate labelled container	23	93	1	7
Being aware of soil, air, and water as contaminants	21	87	3	13
Piling sacks in flat form is the best storage practice for raw materials	19	79	5	21
Using of water and soap followed by chlorine solution is the best way to clean counters and other surfaces that come in contact with food	16	67	8	33

Table 2a continued...

FOOD SAFETY DIMENSION	KNOWLEDGEABLE		NOT KNOWLEDGEABLE	
	Freq.	%	Freq.	%
Designing food processing establishment properly for adequate mobility of equipment during production, maintenance and sanitation	14	58	10	42
Sanitizing all food contact surfaces as frequent as necessary	14	58	10	42
Providing separate storage for raw and ready to eat food to prevent cross contamination	13	54	11	46
Providing slopping floor type should be provided in the chichacorn processing plant	11	46	13	54
Production and Processing				
Inspecting corn kernels before receiving is a priority measure for delivered corn kernels	18	75	6	25
Improperly storing of corn kernels causes mold growth that produces aflatoxin	11	46	13	54
Hot smoking oil produces free radicals	5	21	19	79
Analysis of Finished Products				
Analyzing finished goods should be part of routine check before product is released for shipment	4	17	20	83

could come from soil, air, and water. Proper storage could also prevent growth of microorganisms, which the respondents know could cause illness. Majority (67%) of the respondents knew that water and soap, followed by chlorine solution are the best materials for cleaning counters and other contact surfaces. However, it was observed that most respondents used water and soap alone in cleaning contact surfaces and equipment. Sanitizing was rarely done in the plant.

Production and processing. A big majority (75%) of the respondents knew that corn kernels should be inspected first before these are received to ensure quality processing. Particularly, corn kernels should be free from insect infestation and varietal mixture. Less than half (46%) of the respondents knew that if the corn is not properly stored, molds that produce aflatoxin might grow. Only one-fifth (21%) of the respondents knew that substances like free radicals could be formed in hot smoking oil. When the oil reaches its smoke point, further heating would lead to oil disintegration, which produces substances that could cause illness such as cancer.

Analysis of finished products. Less than a fifth (17%) of the respondents

knew that analyzing finished goods should be a part of the routine check before the product is released for selling or shipment. However, it was observed that product analysis was not usually done by the processors.

On the whole, the respondents were moderately knowledgeable ($\bar{x}=12$) on food safety. This implies that the respondents have just enough knowledge on the food safety dimensions, which could be attributed to their exposure and involvement in the different food safety programs. However, in order to ensure that the respondents will be able to gain more knowledge on food safety, there should be a constant exposure to training programs and seminars.

Respondents' Beliefs on Food Safety

Beliefs of the respondents on food safety were determined based on a 15-item test on food safety. Although majority (75%) of the respondents believed that knowledge and skills in the chichacorn production are needed for the success of the business, all of them agreed that chichacorn owners and workers need to undergo proper training on food handling to reduce the incidence of foodborne illnesses. Likewise, they believed that aside from dogs, cats, and birds as

Table 2b. Respondents' knowledge level on food safety in the chichacorn industry in Ilocos Norte.

KNOWLEDGE LEVEL	RANGE OF SCORE	FREQUENCY	PERCENTAGE
High	14-20	12	50
Moderate	7-13	11	46
Low	0-6	1	4
Mean	12		
Descriptive Interpretation	Moderate		

sources of contaminants, food handlers could contaminate their products in many ways. Proper handling and food production processes are important in producing quality chichacorn and in reducing risk of diseases like cancer.

In the production process, respondents believed that inspecting raw materials conducted even those from trusted sources ensures quality. The respondents believed that if they have cough, the product could be contaminated. They also believed that scratching one's head and touching one's face (54%), as well as harboring of dust during drying (42%) could affect product quality. However, majority of the respondents believed that the dust accumulated while drying can be removed during washing, and that cooking surely kills microorganisms.

Respondents asserted that water alone is not enough to clean their equipment, and that boiled corn remains should be removed from the boiling pot. Tables and food contact surfaces should be cleaned as frequent as necessary. Almost all (92%) of the respondents

believed that microorganisms harbor on wood. However, it was observed that most of the tables used specially during packaging are made of wood.

Although the respondents had moderate knowledge on food safety, they had a highly favorable belief on food safety practices in chichacorn production. This implies that despite moderate knowledge level, the respondents are guided by their food safety practices based on a set of beliefs. What is important to them is that their products are clean and safe.

Respondents' Work Behavior

Respondents were given a 15-item test on food safety emphasizing on behavior related to personal hygiene, processing, and product safety.

Personal hygiene. Almost all (92%) of the respondents said that they followed food safety rules as models for the workers. Respondents' behavior on the practice of proper personal hygiene shows that almost all of the respondents took a bath before going to work,

Table 3a. Respondents' belief on food safety in the chichacorn industry.

INDICATOR STATEMENT	FAVORABLE		UNFAVORABLE	
	Freq.	%	Freq.	%
• Right knowledge in food handling can reduce the incidence of foodborne illness	24	100	-	-
• Possible contamination occurs when food is accidentally coughed on	24	100	-	-
• Water alone is inadequate to clean equipment and utensils	24	100	-	-
• It is a must for chichacorn owners and workers to receive appropriate training in food handling	22	92	2	8
• Food handler can be a source of contamination	22	92	2	8

Table 3a continued...

INDICATOR STATEMENT	FAVORABLE		UNFAVORABLE	
	Freq.	%	Freq.	%
• Wooden utensils are not safe in processing	22	92	2	8
• Presence of pets in the production can cause food contamination	21	88	3	12
• Properly prepared chichacorn keeps customers from illness such as cancer	21	88	3	12
• Knowledge and skills in chichacorn production is sufficient for business success	18	75	6	25
• Cooking is a sure way to kill microorganisms	18	75	6	25
• Dust harbored during drying does not affect product quality	14	58	10	42
• Scratching of the head or touching the face while producing chichacorn does not affect the quality of the product	11	46	13	54
• Cleaning of tables and other food contact surfaces is done only when needed	8	33	16	67
• It is okay if fragment of boiled corn remains in the cooking pot, anyway, contaminants will be destroyed during boiling	7	29	17	71
• Inspection of corn delivered kernels is not necessary before accepting them from trusted sources	2	8	22	92

Table 3b. Level of the respondents' belief on food safety in the chichacorn industry in Ilocos Norte.

BELIEF LEVEL	RANGE OF SCORE	FREQUENCY	PERCENTAGE
Highly Favorable	11-15	15	63
Moderately Favorable	6-10	9	37
Unfavorable	0-5	-	-
Mean	11		
Descriptive Interpretation	Highly Favorable		

removed their jewelry before working (83%), and cleaned their fingernails before handling anything to prevent contamination (79%). Others (79%) also stressed that they would not report to work if they have illnesses or wounds in their hands.

Processing and product safety. Cleanliness and product safety during processing were also practiced in the plant. All of the respondents said that they put all things in their proper places and properly clean equipment used before and after processing. They do not also smoke during processing. More than half (54%) indicated that they wear an apron

and hairnet during processing and majority (62%) used proper footwear inside the plant.

Generally, respondents' level of work behavior in producing chichacorn was highly desirable (Table 4b). This implies that the respondents behave in such a way that enables them to produce safe products.

Environmental Condition of the Manufacturing Plants

All owners had their own production areas; majority of which were extension of their houses while others were built as

Table 4a. Food safety work behavior of the respondents' in the chichacorn industry.

INDICATOR STATEMENT	PRACTICED		DID NOT PRACTICE	
	Freq.	%	Freq.	%
Personal Hygiene				
• Follow food safety rules to be a model for the workers	22	92	2	8
• Take a bath before going to work	22	92	2	8
• Remove jewelry before working	20	83	4	17
• Give attention to the cleanliness of fingernails.	19	79	5	21
• Work even despite of having fever or wounds in hands	19	79	5	21
Processing and Product Safety				
• Place things in designated areas.	24	100	0	0
• See to it that the equipment is clean before and after using	24	100	0	0
• Avoid cigarette smoking during production	24	100	0	0
• Make sure that the production area is clean	23	96	1	4
• Prepare food in sanitary way even if there is a rush order	23	96	1	4
• Clean and wash the drying area after use	22	92	2	8
• Eat while working at the production area	20	83	4	17
• Cook chichacorn with the health of the consumers in mind	19	79	5	21
• Use different footwear inside and outside the processing plant	15	62	9	38

separate units. Half of the owners had sufficient space for their equipment, production, maintenance, and sanitation activities (Table 5a).

Inside the processing plant. All processing plants had accessible toilet facilities and floors that are always kept dry especially after production. Almost all were provided with ventilation and lights. Likewise, most of the chichacorn processing plants had sufficient water supply for adequate sanitary measures to meet the processing and cleaning needs and employees' sanitary requirements.

Additionally, most processing plants had storage rooms for raw materials, semi-processed and processed corn, equipment, and packaging. Others had storage rooms containing different items.

Majority (57%) of the processing plants were screened for protection from pests specially on areas used for storage and packaging. Cooking and washing were done in an open area in the processing plant, therefore giving proper ventilation and lighting during processing. It was observed that some of the owners had their cooking areas where boiling was done under a tree. All of them had sufficient water to use during processing, which usually came from treated deep wells.

Signage for instructions, reminders, and warning signs were available in two processing plants. Half of the respondents provided trash receptacles with cover within the processing plant.

Outside the processing plant. All of the processors had waste disposal areas, which were usually dug pit or septic tanks. Grass or weeds were observed to be abundant in the surroundings of the majority (65%) of the processing plants, as well as in places where boiled corn was dried. The respondents did not consider it as an alarming hazard. It should be noted that weeds and grasses are possible breeding grounds for pests and pathogenic microorganisms.

It was observed that a big majority (71%) of the plants had no stagnant water around their premises. Water that was usually collected around the production area came from the washings used for boiling corn. During rainy seasons, producers from Paoay encountered problems on water and mud within the premises of their plants. This also affected safety of the water source, since it was only drilled. According to one of the respondents in Paoay, there was a time (in year 2008) when he stopped producing chichacorn due to the floods. That was so, because the product would be affected by the quality of water supply. Indeed, chichacorn processing needs sufficient amount of safe water specially in boiling and washing of corn kernels.

Table 4b. Level of respondents' work

BEHAVIOR LEVEL	RANGE OF SCORE	FREQUENCY	PERCENTAGE
Highly Desirable	11-15	20	83
Moderately Desirable	6-10	4	17
Undesirable	0-5	-	-
Mean	13		
Descriptive Interpretation	Highly Desirable		

Table 5a. Environmental condition of the processing plant of the chichacorn industry (n=14).

INDICATOR STATEMENT	Complied		Not Complied	
	Freq.	%	Freq.	%
Inside the Processing Plant				
• Accessible toilet facilities are maintained in sanitary conditions	14	100	-	-
• Floors are kept dry after production	14	100	-	-
• Proper ventilation and lights are provided	13	92	1	8
• Sufficient water supply of adequate sanitary measures and sufficient temperature to meet the needs for processing and cleaning and employees' sanitary requirement	12	85	2	15
• Provision for separate storage room for equipment	11	79	3	21
• Provision for separate storage room for raw materials	11	79	3	21
• Provision for separate storage room for semi-processed/processed kernels	11	79	3	21
• Provision for separate room for packaging	10	71	4	29
• Doors are kept closed	9	64	5	36
• Absence of pets around and inside processing plant	9	64	5	36
• Provision of hand washing station with sufficient water, soap and towel in the production area	9	64	5	36
• Provision of adequate screening or protection against pest	8	57	6	43
• Provision of trash receptacle with cover	7	50	7	50
• Provision of sufficient space for equipment, production, maintenance and sanitation activities	7	50	7	50
• Provision of exhaust fans	2	14	12	86
• Provision for signage for information and reminders to personnel	2	14	12	86
Outside the Processing Plant				
• Provision of waste disposal area outside the plant	14	100	-	-
• No standing/stagnant water around plant premises	10	71	4	29
• Roads and park yards are free from dirt and mud	9	64	5	36
• No weeds/tall grasses around plant premises	5	35	9	65

It was observed that some (36%) plants were located near dirty and muddy roads and park yards. Another problem encountered by the producers was uncemented roads, which produced dust whenever vehicles passed by the processing plant. However, the Paoay producers remedied that problem by cementing the roads going to their production area through the help of the LGU. The Pinili producers were still being burdened with such a dilemma, especially so that their drying area was near the road.

In some processing plants, pets, especially dogs and cats, could enter freely because their production areas were not enclosed. One of the respondents had a cattle shade which was near their cooking, packaging and storage area. According to WHO, animal wastes could be a source of *E. coli*, a pathogenic microorganism that could be hazardous to health when food has been contaminated with it through cross-contamination during food preparation and use of contaminated surfaces and kitchen utensils.

On the whole, the environmental condition of the processing plant was

found to be moderately favorable with a mean score of 13. This implies that the owners met the required environmental conditions of their processing plants, which are conducive for producing chichacorn safely.

Respondents' Processing Practices

Table 6a presents the respondents' practices in processing chichacorn. They were grouped into seven major activities, namely: inspection, storage, boiling, drying, frying, addition of flavoring and packaging (Figure 1).

Inspection. Corn kernels used for processing were bought from local farmers. When these were delivered, respondents ensured the cleanliness and suitability of the materials for processing. Based on the enumerated practices, size of the kernels and possible insect infestation were the basis for inspection. Corn kernel moisture content is considered by majority (58%) of the respondents; however, a big majority (79%) of them evaluated corn kernel based on the acceptable moisture through visual inspection rather than using a moisture meter.

Table 5b. Level of environmental condition of the processing plant of the chichacorn industry.

LEVEL OF ENVIRONMENTAL CONDITION	RANGE	FREQUENCY	PERCENTAGE
Highly Favorable	14-20	14	58
Moderately Favorable	7-13	8	34
Unfavorable	0-6	2	8
Mean	13		
Descriptive Interpretation	Moderately Favorable		

Storage. Availability of corn kernel was seasonal. As such, processors were forced to store large volume of raw materials during peak season. Good practice of proper storage should be observed to minimize insect infestation, cross contamination, and moisture absorption. The respondents properly stored corn by using sacks lined with plastic bags. These sacks were filed on platforms by most (88%) of the respondents, which was parallel to the result of their knowledge on the best storage practice of raw materials. On the other hand, majority (60%) had exclusive rooms for raw materials storage.

Boiling. Corn is boiled twice. Prior to boiling, corn kernels were washed as practiced by majority (67%) of the respondents. The first boiling was done to peel off the corn kernels' pericarp using

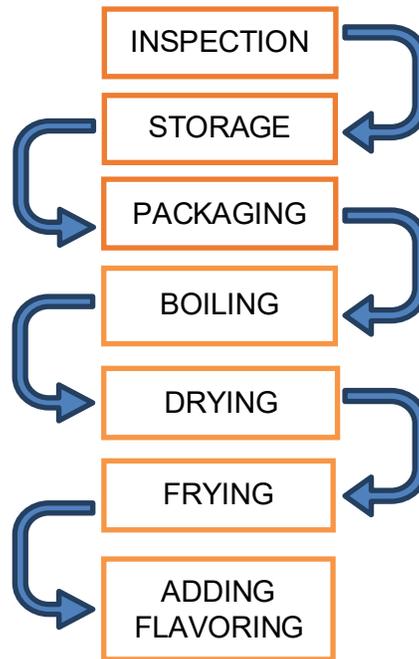


Fig1. Flowchart of chichacorn processing

Table 6a. Respondents' food safety practices in the chichacorn industry in Ilocos

INDICATOR STATEMENT	PRACTICED		DID NOT PRACTICE	
	Freq.	%	Freq.	%
Inspection				
Corn kernels are inspected based on moisture content	14	58	10	42
The moisture content is determined through a moisture meter	5	21	19	79
The moisture content acceptable to corn is 14-16%	-	-	24	100
Storage				
Storage containers are filed on platforms	21	88	3	12
There is provision for separate room during storage	16	67	8	33
Sealed container is used in storing corn kernels	-	-	24	100
Boiling				
Corn kernels are washed before boiling	16	67	8	33
Amount of added lime is according to GMP	0	0	24	100
Completeness of washing is determined through litmus or chemical tests	-	-	24	100

Table 6a continued...

INDICATOR STATEMENT	PRACTICED		DID NOT PRACTICE	
	Freq.	%	Freq.	%
Drying				
Drying facilities are cleaned, washed and sanitized	21	88	3	12
Mechanical dryer is used for drying corn kernels	2	10	22	90
Endpoint of drying is determined through moisture content	-	-	24	100
Frying				
Vegetable oil is used for frying	24	100	-	-
Frying oil temperature is maintained at 375°F	2	10	22	90
Frying endpoint is determined with moisture content of 3%	-	-	24	100
Mixing of Additives and Flavorings				
Drying facilities are cleaned, washed and sanitized	24	100	-	-
Flavorings And additives are mixed right after frying	22	92	2	8
Flavorings and additives are mixed through a mixing equipment	5	21	19	79
Packaging				
Packed fried corn is sealed with an electric sealer	20	83	4	17
Product is packed in designated packaging room.	9	38	15	62
Table used in packaging is made of stainless steel	-	-	24	100

lye solution. Lye or sodium hydroxide was widely used for peeling of fruits and vegetables. According to CODEX, acceptable amount of lye used in processing should be in accordance with GMP, or a standard set by the manufacturers, which would be effective for its particular use. It was observed that respondents used varying amounts of lye solution when boiling corn. Each producer had his/her own proportion of lye per kilogram of corn. The second boiling was done after the pericarp was removed in order to soften the corn kernel.

After each boiling, the corn kernels were washed under running water to remove the pericarp as well as the lye added. It was observed that respondents did not employ tests to determine if the washed corn was lye-free.

Drying of boiled corn. Washed boiled corn was dried immediately to prepare it for frying. This was also done to prevent spoilage, bacterial infestation, and mold growth. Prior to drying, activities to prepare drying equipment were done by most (88%) of the respondents such as cleaning/washing/sanitizing and inspecting for possible hazardous elements.

Almost all (90%) of the respondents used improvised drying equipment, which was made up of galvanized iron or bamboo slots lined with plastic net. They were built in an open area located at the side or back of their house or processing plant. On the other hand, only few (10%) of the respondents used mechanical dryer.

Solar drying usually takes three to four days, while mechanical drying takes just hours to dry corn kernels. The boiled products are susceptible to microbial pathogenic growth when exposed in an open air since water activity is increased, thus, time and temperature controls are required to assure product safety. The endpoint of drying is usually based on the color and texture of the kernels.

Frying. Vegetable oil should be used in frying corn as set by BFAD standards in chichacorn production. It was observed that all of the respondents complied with this requirement. During frying, the oil was maintained at 375°F to prevent oil deterioration; hence, quality fried corn was produced. Only two (10%) of the respondents monitored the temperature of cooking oil during frying while others relied on the smoking point of the oil.

The best practice to determine if corn kernels were properly fried is to have a 3% moisture content (BFAD, Draft Standards for Fried Corn Snacks); however, no one practiced it. The quality of fried corn kernels was only determined by their color and texture (crunchiness) when they float.

Mixing of additives and flavorings. In order to enhance the taste of the corn,

all of the manufacturers added garlic, salt, MSG, flavorings for product variation such as cheese, barbeque, spicy/sweet, and spicy. Prior to mixing, all of the respondents cleaned, washed, and sanitized the mixing facilities or equipment. Almost all (92%) of the respondents mixed additives and flavorings right after frying, while the rest (8%) mixed them after cooling. Only few (21%) owned and used a mechanical mixer for additives and flavors.

Packaging. Flavored fried corns are packed after attaining the desired temperature. Packaging protects the product from airborne contamination and moisture pick-up, as well as controls water activity (a_w); hence, it prevents the growth of undesirable microorganisms.

Only few (38%) of the respondents had a room exclusively used for packaging. Majority (62%) packed inside their house or in an available area within the plant. The recommended table should be made of stainless steel; however, none of the respondents had such table. Most (83%) of the respondents used impulse or bond sealer for packaging.

On the whole, Table 6b indicates low level of food safety practices (7), which implies that some food safety requirements were not properly followed by chichacorn producers in Ilocos Norte.

Correlation of Variables and Food Safety Practices

Respondents' Characteristics

Table 7 shows that age, educational attainment, years in the business and

seminars/training programs attended are not significantly correlated to their food safety practices.

Factors of Safety Practices

The correlation between the four factors of food safety and the existing food production safety practices of chichacorn shows that knowledge ($r=0.671$), belief ($r=0.551$), and environmental condition of the processing plant ($r=0.753$) were highly significant, while work behavior ($r=0.413$) was only significant at 0.05 level of significance (Table 7). This means that food safety was practiced if the workers know these, believe in their importance, act accordingly, and work in a well-equipped and maintained environment.

A review done by Wilcock et al (2003) on food safety issues revealed that if people knew or learned that their current practices are unsafe, they are willing to change such. Therefore, it is important

to educate food handlers regarding the positive outcomes of safety practices in food production to reduce foodborne diseases, to keep a clean working environment, and to reduce the spread of microorganisms via processing protocols.

A research done on Australia’s consumer awareness, knowledge, and attitude toward food safety issues revealed that respondents who recalled seeing, hearing or reading information about food safety tend to have better food safety practices than those who had no recall of food safety messages or information (http://www.health.vic.gov.au/foodsafety/research/food_safety_knowledge.htm2/5/2009). However, studies done by the Research Triangle Institute International revealed that teaching the recommended safe food handling is sufficient. Motivation to follow the food safety recommendations should be given so that the food handlers may understand the risk of unsafe food handling, hence, warrants extra

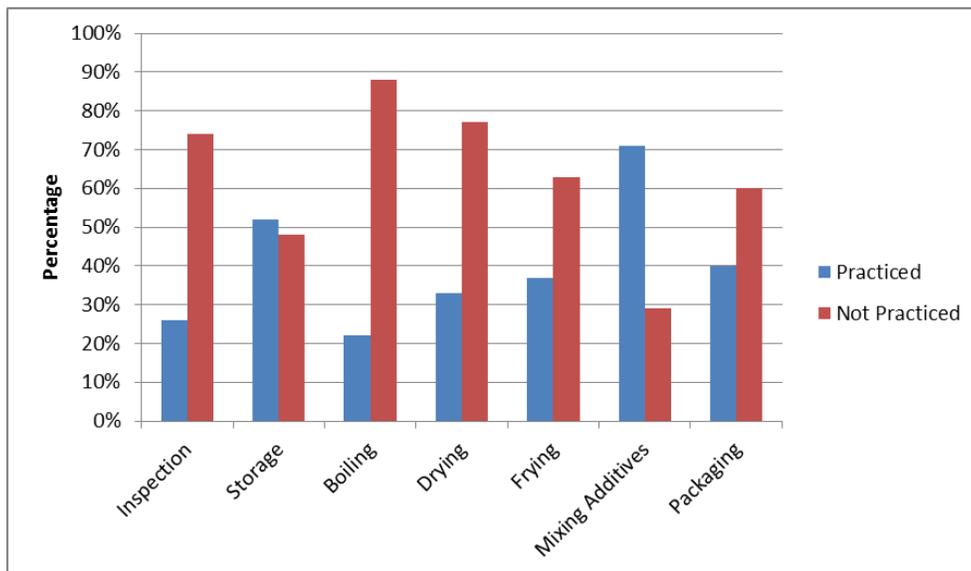


Fig. 2. Respondents’ food safety practices in producing chichacorn

precaution. This was suggested because those studies revealed that despite the respondents' knowledge on the proper thing to do, i.e. washing of hands with soap and water after handling raw foods, only few respondents actually practiced it (<http://www.mewswise.com/articles/view/533347-11/09/2008>). Another study revealed that food handlers do not practice safe food handling due to their limited knowledge on the "how to's" in making food safe to eat (Wilcock et al 2003).

Studies on of consumers' behavior towards food safety show that the willingness to change behavior is determined by attitudes and beliefs. This means that in order to implement the food

safety practices, the people should have positive attitudes and beliefs toward food safety, which leads them to take action (application). In order to change, the person has to realize that his/her current practices endangers his/her health and that taking action (positive application) has a strong likelihood of reducing it. Furthermore, if positive attitude for change is absent, expected action that would lead to change will not happen. This would therefore explain the low level of the existing food safety practices of the chichacorn industry.

Conclusions and Recommendations

Half of the respondents had already been working in the chichacorn industry

Table 6b. Respondents' level of food safety practices in processing chichacorn in Ilocos Norte.

KNOWLEDGE LEVEL	SCORE RANGE	FREQUENCY	PERCENTAGE
High	15-20	-	-
Moderate	8-14	8	63
Low	0-7	18	37
Mean	7		
Descriptive Interpretation	Low		

Table 7. Correlates of food safety practices among chichacorn processors in Ilocos Norte.

VARIABLE	COEFFICIENT
Respondents' Characteristics	
Age	-0.388 ^{ns}
Educational attainment	-0.082 ^{ns}
Years in the business	-0.225 ^{ns}
Seminars/training programs attended	0.222 ^{ns}
Factors of Food Safety Practices	
Knowledge	0.671**
Belief	0.551**
Work behavior	0.413*
Environmental condition	0.753**

for 10 years, while some had been in the industry for more than 20 years. Most of the workers were middle aged, majority were females, and almost all had attended formal schooling. They had likewise attended seminars and training programs that are related to food safety and food preparation such as cGMP and HACCP.

Owners and workers had moderate knowledge level on food safety, which could be attributed from their exposure to training programs and seminar sponsored by government agencies such as the DOST and FNRI. Majority of them were aware that GMP is a food safety program required by BFAD for food establishments and were knowledgeable on personal hygiene, importance of properly designed establishments, production and process controls. However, they were not well aware of some food safety concepts and their effects on the production of safe food. Insufficient implementation of GMP with regard to equipment and facilities was due to limited capital.

The respondents' beliefs on food safety practices were highly favorable. Majority of the respondents acknowledged that training programs on proper food safety practices contributed to the success of their business. They also recognized the importance of personal hygiene, good health, proper equipment, sanitary environment, and regular inspection to develop quality products. In addition, the respondents had a highly favorable work behavior in relation to steps followed in chichacorn production.

Based on observation, the environmental condition of the chichacorn processing plants was moderately favorable. However, there were insufficient storage rooms for raw

materials, semi-processed corn, equipment, and packaging utilities. Although all had their own facilities for cooking and washing, disposal areas were usually dug pits or septic tanks and the smell of the wastes posed a threat to the environment. Grass or weeds were found around the processing plants. Most have dusty roads and parking lots nearby. During rainy seasons, some plants were flooded.

Level of compliance with food safety practices during the production was low, because respondents claimed they were not aware of some technical requirements such as the proper moisture content for raw and cooked corn, the right amount of time to spend, the proper temperature maintained in frying. Some did not have their own equipment for drying, mixing and packaging. Additionally, production processes were still manual and traditional.

There was no observed relationship of the respondents' personal characteristics such as age, educational attainment, years in the business, as well as number of seminars or training programs attended and their food safety practices. On the other hand, knowledge, beliefs, work behavior, and environmental condition of the plants had positively significant relationship with existing practices of food safety in chichacorn production.

In light of the findings, the following recommendations are forwarded:

The owners and workers in the chichacorn industry should continually attend training programs and seminars related to food safety to enhance their knowledge, beliefs, and attitudes toward food safety practices.

To ensure product quality, process standardization should be undertaken based on the Philippine National Standard for Fried Corn and Codex Alimentarius to address critical control points and address low level food safety practice.

The owners should comply with the provisions of the environmental condition processing plant as provided in the GMP to ensure product safety and quality in every facet of the product process flow.

Acknowledgement

The researchers would like to thank the leader and staff of the MMSU-NEDA-DBP Project for their support in conducting this research; colleagues who in one way or another shared wisdom and insight for the improvement of the research; all owners and workers of the chichacorn establishments for opening their doors and allowing us to gather important data needed; and above all, God Almighty for orchestrating all things to make this research a success.

Literature Cited

- Abadilla C.P., F.A.P. Acebedo, O.M. Agpaoa and C.M. Pascual.** 2007. Food Processing in Ilocos Norte: Current Practices, Product Quality and Production Standardization.
- Ajzen I, and M. Fishbein.** 2000. Attitudes and the Attitude-behavior Relation: Reasoned and Automatic Processes. *European Review of Social Psychology*. Chichester, England: Wiley. pp. 1-33.
- Ajzen, I. and M. Fishbein.** 2005. The Influence of Attitudes and Behaviour.

The Handbook of Attitudes. Mahwah, N.J.: Lawrence Erlbaum Associates Publishers. pp. 173-221.

- Albano, L.R.** 2004. Correlates of Performance of Women Leaders of Agrarian Reform Communities Development Project (ARCDP). Unpublished Master' Thesis. Mariano Marcos State University, Laoag City. p. 77.
- Altekruse, S.F., D.A. Street, S.B. Felin and S.A. Levy.** 1995. Consumer Knowledge of Foodborne Microbial Hazards and Food-handling Practices. *Journal of Food Protection* 59(3):287-294.
- Andres, T.D.** 1983. Understanding Values. Second Impression. Quezon City. Philippines: New Day Publishers.
- Djuretic, T.** 1996. General Outbreaks of Infectious Intestinal Disease in England and Wales: 1992 to 1994 in *CDR Rev.* 6, R57-63.
- FAO/WHO.** Assuring Food Safety and Quality: Guidelines for Strengthening National Food Control System. www.who.int/foodsafety/publications/fs/guidelines-food-control/en-Dec26
- FDA.** 2004. Good Manufacturing Practices (GMPs) for the 21st Century – Food Processing: Section One: Current Food Manufacturing. Center for Food Safety and Applied Nutrition.
- Federal Register 51.** 1986. Part 110-Current Good Manufacturing Practice in Manufacturing, Packaging, One Holding Human Food. *Federal Register* 51. June 15. <http://www.cfsan.fda.gov/~lrd/cfr110.html>

- Harris, L.** 1997. *Hamburger Hell: Better Risk Communication for Better Health in Mad Cows and Mothers Milk: The Perils of Poor Risk Communication.* McGill-Queen's University Press, Quebec. pp.77-98.
- Hine, S., D. Thilmany, P. Kendall and K. Smith.** Employees and Food Safety: Is Training Important to Food Service Managers? *Journal of Extension* 41 (1):2-3.
- Klotz, K.C., B. Timbo, S.B. Fein and S.A. Levy.** 1995. Prevalence of Selected Food Consumption and Preparation Behaviors Associated with Increased Risks of Foodborne Disease. *Journal of Food Protection* 58(8):927-930.
- Knabel, S.I.** 1995. Foodborne Illness: Role of Home Food Handling Practices. *Scientific Status Summary. Food Technology* 49(4):119-31.
- McArthur L.H., L. Holbert, and W.A. Forsythe.** 2006. Compliance with Food Safety Recommendations Among University Undergraduates: Application of the Health Belief Model. *American Association of Family and Consumer Sciences. Research Journal. Carolina.*
- Nieto-Montenegro S., J.L. Brown and L.F. Laborde.** 2006. Using the Health Action Model to Plan Food Safety Educational Materials for Hispanic Workers in the Mushroom Industry. *Food Control.*17.
- Pradish, C.** 1999. Food Trade and Implementation of the SPS and TBT Agreements: Challenges for Developing Countries in Meeting the Obligations of the SPS and TBT Agreements and the Codex Alimentarius Conference on International Food Trade Beyond 2000: Science-Based Decisions, Harmonization, Equivalence and Mutual Recognition. <http://www.fao.org/docrep/meeting/X2666E.htm>
- Ramos, A.C. and C.A. Oblepias** 2002. *FAO/WHO Global Forum on Food Safety Regulators: Country Report Proposed by the Philippines.*
- US FDA,** 2004. Section One: Current Food Good Manufacturing Practices. Center for Food Safety and Applied Nutrition. <http://www.cfsan.fda.gov/dms/gmp-1.html>. October 4, 2008.
- Valdez, K.M.** 2007. Ilocos Norte's 'Cornik' Makes Headway in International Market.<http://www.manilatimes.net/national/2007/feb/08/yehey/business/20070208bus4.html>
- Wilcock. A., M. Pun, J. Khanona, and M.Aung.** 2003. *Consumers Attitudes, Knowledge and Behavior: A review of Food Safety Issues.* Elsvier Ltd.: Canada.
- http://www.health.vic.gov.au/foodsafety/research/food_safety_knowledge.htm
2/5/2009
- <http://www.mewswise.com/articles/view/533347-11/09/2008>
- <http://www.agnetwork.com/content.asp?contentid=261846-01/16/2009>
- <http://food.oregonstate.edu.html>
- http://www.news-medical_net/?id=29874-09/14/2008