

# Good Manufacturing and Hygienic Practices at Small and Medium Scale Pineapple Processing Enterprises in Rwanda

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## Abstract

The purpose of this study was to assess the compliance of small and medium scale pineapple processing enterprises in Rwanda to the Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) as set by the national, regional and Codex Alimentarius Commission (CAC) food safety and hygiene regulations. The layout design and practices of hygiene for 16 small and 11 medium pineapple processing enterprises were characterised by conducting face-to-face interviews using questionnaires and observations. None of the visited enterprises had clear criteria of the delivery procedure of raw pineapples and none had a signed contract with the suppliers and this led to uncontrolled primary production. The plant layout and design of both small and medium enterprises were characterised by insufficient number of working rooms and there was crisscrossing in the production line of 81.8% and 87.5% respectively for medium and small enterprises. The clean and unclean sectors were only separated at 63.6% and 31.2% of the medium and small enterprises respectively. In generally, the status of all enterprise categories, their surrounding areas and equipment was classified as unsatisfactory. The majority of enterprises did not have temperature and time control systems and for both enterprise categories, there was no clear plan for waste disposal, plus pest and insect control. Lack of compliance to the standard requirements was observed in the majority of both enterprise categories. In order for these enterprises to access export market, it is recommended that training on the requirements for GMP and HGP for food processing industries by the Rwanda Bureau of Standards and other government and non-government institutions be provided. Training programs on basic food safety and hygiene in food processing enterprises need to be in place to support implementation of prerequisite programs in the small scale fruit processing enterprises.

**Keywords:** Good manufacturing practices, Small and medium enterprises, Pineapple processing, Standards

## 1. Introduction

Food-borne diseases can damage trade and tourism and lead to loss of earnings and unemployment (da Cruz *et al.* 2006). Effective food hygiene control is of great importance to avoid consequences of food-borne diseases, injury and spoilage on human health and economies (CAC 1997). In order to address this concern, food hygiene practices have been translated into a guideline, aiming at establishing processing, handling, transport and distribution procedures that are apt to prevent deterioration due to microorganisms, growth of pathogens on foodstuff, contamination and recall procedures, maintenance and sanitation, personnel hygiene and training of personnel (Will and Guenther 2007). In Rwanda, compliance to these international codes for food hygiene at small scale level is still questionable and this leads to products of low quality (RHODA 2008; Austin *et al.* 2009). GMP with the objective of controlling the changes in the food composition that may happen during the processing and manufacturing gives the trend in food hygiene and is recommended in food enterprises to enhance the desired qualities in the product and also to ensure food safety, stop or slow down any deterioration in the food (da.Cruz *et al.* 2006). According to Henson (2003) and Henson & Jaffee (2008), complying with international food safety standards is still a major challenge for food processing companies of developing countries due to many constraints including lack of appropriate processing facilities. This leads to products which are not acceptable in export market of European Union and other developed countries. In addition, the World Bank (2005) recognized that weaknesses such as lack of strong legislative frameworks, non-compliance to international standards, lack of

surveillance and inspection systems and procedures, lack of laboratory testing capacity, lack of food processing capacity and coordination may also hamper food processing companies of developing countries to access the export market of European Union (EU) or USA. Ehri *et al.* (1995) listed the following as some of the important factors which increase the risk of food contamination and food borne diseases in developing countries: (i) the use of night soil for crop cultivation, (ii) poor standards of hygiene, (iii) lack of basic sanitation facilities, (iv) contaminated water supply, (v) inadequate or lack of food safety infrastructure, (vi) climatic conditions favouring the multiplication of microorganisms, (vii) lack of food technology and quality assurance techniques, (viii) inadequate cooking or reheating, (ix) inadequate temperature control during cold and hot storage of foods, (x) cross contamination in food premises, and (xi) use of contaminated raw materials and infected food handlers. In order to ensure food safety in any food processing enterprises either big or small, the international organizations have set minimum food hygiene standards to be applied in order to minimize food contamination (Chaudhary 2005).

## 2. Objectives of the study

The aim of this study was to assess the compliance to the practice of hygiene at small and medium pineapple processing enterprises in Rwanda to Codex guidelines on good manufacturing and hygiene practices in food processing enterprises.

## 3. Data collection and questionnaire design

This was a cross sectional study design that examined what was happening at small and medium scale pineapple processing enterprise level at a particular point in time. We conducted a census survey in Rwanda from July to August 2011 at small scale pineapple processing enterprises (N=16) and medium scale pineapple processing enterprises (N=11) across the country. A guideline booklet containing the list of food processing enterprises published by Rwanda Horticulture Development Authority in 2008 (RHODA 2008) was used to identify enterprises. We collected data by interviewing managing directors using a structured questionnaire with closed and open-ended questions as well as visual observations. The questionnaire was structured to gather information concerning: primary production, location and surroundings, layout design and establishment of premises, equipment, facilities, waste disposal, hygiene and sanitation, packaging and labeling. Statistical data were generated using Statistical Package for the Social Sciences (SPSS) version 16.0.

## 4. Results and Discussion

### 4.1 Primary production

Primary production is one of the important aspects in the food processing chain when considering food safety and hygiene in any food processing enterprise. The results indicated that some of the processed pineapple fruits were in processors' farms and others were buying pineapples outside their farms. There was no special control of contamination of pineapple farms moreover suppliers were changing depending on whether a farmer had ripe pineapples to deliver to the processing plant. No single processing enterprise had a contract with any supplier of raw pineapples and there were no clear written criteria on which the enterprises base their choice of pineapples supplied to them for processing. This current situation at small and medium enterprise level does not satisfy the requirements of international standards for food hygiene which state that food processors should control any contamination source of food to be processed starting by production, handling, storage and transport. According to Chaudhary (2005) any contamination from soil, water, feedstuffs, pests, fertilizers, pesticides, and veterinary drugs should be examined before any processing activity. Ehri *et al.* (1995) recognized that the quality of the end product depends on the status of the raw material; they indicated that it is of crucial importance for food processing units to ensure that food stuffs and ingredients are purchased from safe and reputable suppliers. Thus, food processing enterprises need to set and document clear criteria for the raw material to be supplied for processing and have to be in a position to reject items which do not meet set criteria. However, this is not easy for small and medium scale enterprises especially in developing countries; moreover, it has been noted that even in developed countries like United Kingdom, small food enterprises have found to be less likely to invest in hygiene and food safety (Taylor 2001). However, in countries like India and Zimbabwe where food processing enterprises are growing and targeting to access export market, food safety and hygiene is becoming a priority from handling, processing to marketing. According to Deininger and Sur (2007) and Henson *et al.* (2005) processing enterprises are still facing challenges in complying with the required international food safety and hygiene regulations. Small

and medium pineapple processing enterprises studied should therefore be trained on the importance of having in place all the characteristics of the raw pineapples delivered to them to ensure the safety of the final product. Missing this step of strict inspection of the health status of the raw pineapples will stop them from accessing the export market because the export market predominantly made of EU and USA have set food safety and hygiene standards which need to be respected before accepting any processed or unprocessed food to enter their territory (Aruoma 2007; CAC 1997).

#### 4.2 Status of layout and design of pineapple processing premises

The results showing status of layout and design of studied pineapple processing enterprises are shown in Table 1. The general appearance of the food processing plant is one of the requirements for the food hygiene prerequisites (Chaudhary 2005). It was noted that most of the processing enterprises were made of bricks and cement representing 81.8% and 100% of small and medium enterprises respectively. Over 81% of the buildings had roofs made of iron sheets. There was only one medium enterprise with a floor made of tiles despite the requirement of the Rwanda Bureau of Standards for tiled floors. About half of the enterprises (56.2% small and 45.5% medium) had the walls painted of water-based latex paint. The remaining enterprises had the walls either oil painted or not painted at all. About a half of both enterprise categories were not able to regularly wash the processing enterprise's walls because they were made of non-impervious painting material required in food processing enterprises (CAC 2003). This lack of regular internal cleaning of the whole enterprise compartments could lead to the production of contaminated food product since cleaning and sanitation is considered as a major aspect of the Good Hygienic Practices in food processing industries (Djekic *et al.* 2011). In general, for most of the assessed criteria, medium enterprises were in good conditions than small ones but there was no significant difference between the two enterprise categories.

Table 2 shows frequencies of compliance to hygiene parameters by small and medium scale enterprises. The layout of food establishment has to ensure a forward food manufacturing process flow in way to avoid cross contamination from the earlier step to the next step in the processing chain. This means that there should be many compartments in a food processing establishment each clearly separated from the other but complementing each other (Chaudhary 2005). However based on these results, this was a big challenge for studied processing plants. Generally, all enterprise categories (small and medium sized) were similar for all parameters observed but with medium scale enterprises performing better than the small scale ones. Results indicated that 81.8% and 75.0% of the medium and small scale enterprises respectively had a special area for food processing. There was no restriction to the entrance for both enterprise categories, however only 45.5% and 25.0% respectively for medium and small enterprises had restriction to enter the processing area and there was a criss-cross in the production line for the majority of medium (81.8%) and small (87.5%) enterprises ( $p>0.05$ ). Only 63.6% and 31.2% of the medium and small enterprises respectively had separated clean and unclean sector and 50% of the small enterprises had a storage room for raw material compared to 81.8% of the medium enterprises. However, of those having the storage room, a half of them for small and medium enterprises were classified as having a not satisfactory clean status of the storage room. Most of the enterprises (62-70%) had a reserved area for washing raw pineapples, processing, filling, capping and labeling and storing the final product. The majority of the enterprises had two entry doors, 82.2 % and 72.7% for small and medium enterprises respectively however, did not have a temperature control system in place. Bas *et al.* (2007) reported that at least 32.2 % ( $n=115$ ) of the studied food businesses did not have a controlled temperature system required during processing. This unsatisfactory condition is not particular to these SMEs. Similar conditions were observed in street food small enterprises in ten countries of western Africa namely Ghana, Mali, Bourkina Faso, Togo, Senegal, Nigeria, Niger, Cote d'Ivoire, Guinea and Benin (Barro *et al.* 2007). Poor design and structure of food processing companies was also reported in Bosnia, Serbia, Herzegovina and Macedonia (Djekic *et al.* 2011).

The results of ventilation and lighting requirements of a food processing room as per Codex requirements are presented in Table 3. The results show that all enterprise categories had natural ventilation. The neutrality of the lighting of the working rooms was scored as not satisfactory for the majority of medium (72.7%) and half of small (50%) enterprises. However, the medium enterprises (54.5%) had working rooms brighter than small enterprises (31.2%) though there was no significant difference ( $p>0.05$ ). Natural or artificial lighting is important in a food processing enterprise but lighting fixtures have to be protected for avoiding any contamination with breakages (CAC 1997).

#### 4.3 Status of sanitation and maintenance

#### 4.3.1 The cleanliness of the processing plant surrounding areas

The results of status of the cleanliness of the processing plant surrounding areas are shown in Table 4. It was found that for the majority of medium enterprises (81.8%, n=9) and small enterprises (56.2%, n=9) the plants were cleanable with the medium enterprises being more cleanable. There was also a tendency for medium enterprises to control the cleanliness of the processing plant surrounding areas than small enterprises though a high percentage of both enterprise categories did not have a cleaning plan in place and a half of the enterprises were scored as not satisfactory regarding the cleanliness of the building surroundings. For all the compliance criteria, there was no significant difference between small and medium enterprise categories.

Of those who control the cleanliness of the surrounding areas of the processing plants, the majority of both enterprise categories do it every day but also some of them do it on weekly basis. There was no enterprise located in a polluted environment. This is a positive aspect regarding food safety because it is normally recommended that food processing units should be located far from a polluted environment and industrial activities which can emit disagreeable odor, fumes, excessive soot, dust, smoke, chemical and biological emissions which can contaminate the foods (Chaudhary 2005). However the fact that the hygiene of surrounding areas of enterprises was not regularly monitored is a limiting factor to the production of safe pineapple products because non-clean surroundings may host rats and flies which are likely to contaminate processing utensils and food products.

#### 4.3.2 Cleanliness of the working rooms

The results of the status of cleanliness of the food processing rooms are presented in Table 5. The findings indicate that most of the enterprises clean the working room's walls once a week or once a month but those enterprises with unpainted walls never clean them. Regarding the cleaning of other processing utensils, there was a significant relationship between the cleanliness of the utensils and the status of the enterprise (Fischer's exact test,  $p=0.00$ ) because small scale enterprises were cleaning utensils only when they had processing activities (81.8%) while medium enterprises were cleaning them every day (72.7%). Considering the smoothness of the wall that allow easy cleaning, a half of small enterprises were scored as not satisfactory while 63.6% of medium enterprises were scored as acceptable (Fischer's exact test,  $p=0.00$ ). Similarly, the walls of small enterprises presented cracks (62.5%) compared to only 18.2 % for medium enterprises (Fischer's exact test,  $p=0.02$ ). Medium enterprises also scored better for the smoothness of the floors and the ceilings and the absence of the cracks at the ceilings than small enterprises (Table 5). In general, medium enterprises' working rooms were in better conditions than small enterprises but they still had significant shortcomings. For instance, both small and medium enterprises did not satisfy the requirements of the brightness of the color of the walls and their washability, the lighting and the washability of the ceilings. However, one of the World Health Organization recommendations is that the ceilings and overhead fixtures have to be designed so as to prevent any accumulation of dirt, condensation, growth of microorganisms and the shedding of paint particles (Chaudhary 2005). These results lead to suggest that both enterprise categories are still having a long way to go in order to adjust themselves to the requirements of the international standard regulations regarding the processing premises in order to be able to export their products (Unnevehr & Jensen 1999).

A strong relationship was observed between enterprise categories and the frequency of cleaning the processing plant, where medium enterprises were cleaning their plants every day (90.9%, n=10) while small enterprises were cleaning their plants only when they had processing activities ( $p=0.00$ ). Similarly, there was a significant difference between both enterprise categories regarding the cleaning of the floor ( $p=0.03$ ). Medium enterprises were cleaning the floor of their enterprises everyday (100%) compared to only 56.2% (n=9) for small enterprises where the remaining cleaned their floor only when they had processing activities (37.6%, n=6). Despite some differences in the cleaning of their processing plants, it was observed that most of all enterprises did not have an overall cleaning plan for the enterprises. This lack of processing plant cleaning and sanitation strategies was also reported by Djekic *et al.* 2011) in certified food processing companies of Western Balkans countries. However, according to CAC (2003), it is recommended that the floors, walls and ceilings of any processing plant be made of impervious, nonabsorbent, washable nontoxic materials, be easily cleanable and disinfected.

#### 4.3.3 Cleanliness of the processing equipment

The results of the status of equipment cleanliness of the processing equipment are shown in Table 6. Results show that equipment in the medium enterprises was more likely to be clean and in good conditions than in small enterprises. A significant difference was observed between small and medium enterprises regarding the smoothness of the equipment ( $p=0.03$ ), the frequency of equipment cleaning ( $p=0.00$ ) and the nature of the

equipment being used ( $p=0.02$ ) and medium enterprises were better scored than small enterprises for the mentioned parameters (Table 6). The majority of both enterprise categories did not satisfy the requirements for the parameters such as equipment not providing required time and temperature control, equipment not clean and maintained enough though medium enterprises were better scored for the cleanliness and smoothness of the equipment than small enterprises. This non-satisfactory status of the processing equipment is unacceptable when considering the international requirement stating that equipment, containers in contact with food during handling, storage, processing, packaging and serving have to be of non-toxic materials and has to be designed, located, and fabricated in a manner that allows its maintenance and cleaning (Henson 2003).

#### *4.3.4 Hygiene status of the working surface and furniture*

The results in Table 7 show the hygiene status of the working surface and furniture for the surveyed enterprises. The results show that slightly over a third (36.4%) and (50%) respectively of the medium and small enterprises respectively had wooden working surfaces. The remaining had surfaces made of plastic, aluminium or stainless steel materials. Only 44.4 % and 25% of the medium and small enterprises respectively were scored as satisfying and or acceptable regarding the desired smoothness of the working surfaces. However, the working surfaces were easily washable for only 36.3% and 25 % for medium and small enterprises respectively. Work surfaces were scored as acceptable and or satisfactory regarding water resistant for only 54.5% and 25% respectively of the medium and small enterprises (Table 7). The design and structure of working surfaces and furniture's in any food processing enterprise is a very important parameter to assess since it plays a major role in ensuring food hygiene (Bas *et al.* 2007).

Overall, the medium enterprises were not in compliance with the requirements of working surfaces and furniture, but conditions were slightly better for medium enterprises than the small enterprises though the differences were not significant between both enterprise categories for all considered parameters ( $p>0.05$ ). According to CAC (2003) equipment and working surfaces should be designed in a way that facilitates the cleaning and hygiene control. Working surfaces need to be made of waterproof and smooth materials. Small and medium pineapple processing enterprises therefore need to renovate their working surfaces and furniture in order to ensure standards compliance with international standards. In the absence of the proposed renovation, it will be difficult to produce pineapple products that are free from contamination.

#### *4.4 Status of basic Facilities*

##### *4.4.1 Water and electricity*

The survey results showed that the majority of medium enterprises (82.0%) reportedly had easy access to electricity compared to a relatively smaller percentage of the small enterprises (44.0%) having easy access ( $p < 0.05$ ). Majority (70.4%) of both small and medium- scale enterprises had access to clean water from Rwanda Electricity, Water and Sanitation Authority (EWSA). Few of the enterprises (29.6%) got water from boreholes because the source of potable water was placed very far from their processing sites.

Few of the enterprises had water stores but those stores were not easy to wash. It is a requirement that in order to assure clean and safe food is produced in any food processing enterprise; potable water is indispensable and has to be stored in proper washable storage facilities for water storage and distribution (Chaudhary 2005). The absence of potable water in some enterprises is not acceptable and poses a serious health problem. According to Sousa (2008) and Henson (2003) there is a close inter-relationship between food safety and other elements of environmental health such as sanitation, water quality and housing conditions. For instance, a study conducted in Liberia by Molbak *et al.* (1989) that assessed the hygiene at household level indicated that 40 to 80% of stored water samples and 19 to 32 % of foods contained a significant number of enterobacteriaceae. Therefore, it is predictable that these pineapples processing enterprises, unless they have running and potable water in their enterprises they will not produce safe products which can be sold to export market.

##### *4.4.2 Drainage and waste disposal*

The results showing compliance to various aspects of waste management are shown in Table 8. All enterprises had a system for disposing waste. However, the system was the traditional pit. All enterprises empty the traditional filled pit once a year and use the waste as fertilizer. These pits are not washable and for a half of the enterprises they are located five to ten meters from the processing buildings. The other half, the pits are located at or beyond fifteen meters. However, it is recommended that wastebin should be placed beyond ten meters from the processing

plant in order to avoid contamination by the flies or off odors. According to Chaudhary (2005), any processing enterprise has to position a waste container in a such way that will not contaminate and pollute the processing area and food. The waste should be kept in a covered container and should not accumulate in food handling, storage or other working environment area. Enterprise rooms did not provide internal drainage to facilitate cleaning water to go out. However, at the time of the visit for the majority of the enterprises there was no stagnant water on the floors, and visible dust on the ground. For the majority of the enterprises there also was no outside drainage and even those few with an outside drainage; the drainage was not protected against the entry of rodents while this is a Codex requirement. These results suggest that there is a need for the surveyed enterprises to implement proper waste disposal and well-designed drainage facilities in order to reduce the risk of water and food contamination.

#### 4.4.3. Insect and Pest control

The results showing the status of insect control in surveyed enterprises are given in Table 9. The results indicated that the majority of enterprises (90.9% medium and 93.8 % small) did not have an insect control system. It was also noted that 31.2 % of the small enterprises were not aware that the equipment must not be placed against the walls in order to facilitate cleanliness of the surrounding environment. The medium enterprises had mosquito nets in the windows to hinder the entrance of insects and dusts. In contrast, only 68.8% of the small enterprises had mosquito nets fitted with windows. Fifty percent of small enterprises had wooden windows and doors compared to only 9.1% of the medium enterprises with wooden doors. None of the medium enterprises had wooden windows however, the relationship was strong between enterprise categories and having wooden windows ( $p=0.01$ ) and wooden doors ( $p=0.03$ ). According to CAC (2003), windows have to be constructed in a way to prevent contamination of food stuffs and sometimes if needed fitted with insect proof screens. They have to be closed during any processing activity.

#### 4.5. Personal hygiene

##### 4.5.1 Personal sanitary facilities

The summary of the results showed that the majority of the enterprises had one latrine toilet room. These latrines (uncovered pits) were separated from the main building. The latrines' location from the main building was  $4.69 \pm 2.67$  and  $5.73 \pm 6.16$  meters for small and medium enterprises respectively. The latrines were in good condition for all enterprise categories, however only two of them (12.5%) of the small enterprises were in bad condition. Latrines were naturally ventilated with open window; 90.9 % versus 75% for medium and small scale enterprises respectively. The remaining enterprises for both enterprise categories were not ventilated, however, with more small enterprises (25%) to be without ventilation than medium enterprises (9.1%). However the ventilation status considered unsatisfactory for the majority of the latrines in both enterprise categories. The overall condition of the latrines for both enterprise categories was similar with small enterprises having less appropriate latrines in terms of sanitation than medium enterprises. All toilets did not have self-closing door while self-closing doors in the latrines is a requirement in a food processing industry (Will & Guenther 2007).

Majority of the medium enterprises had a hand washing place near the latrines (63.6%,  $n=7$ ) comparing to 37.5% ( $n=6$ ) for small enterprises. The remaining enterprises did not have a hand washing facility installed near the latrines. Three out of seven and four out of six respectively of the medium and small enterprises respectively used hand washing soap at the hand washing facility but there was no hot water. Based on the fact that the simple act of washing hands with soap and water can reduce incidents of diarrheal illness by 35% (WHO 2001), these enterprises need to be informed on the importance of installing proper hand washing facilities usable by employees and on the outcomes of washing hands especially in a food processing industry. For 85.7% ( $n=6$ ) of the medium enterprises and 66.7% ( $n=4$ ) of the small enterprises, there was no hand drying system near the latrines and washing facilities for drying hands once they are washed while this is a requirement of the Codex Alimentarius Commission. Also, there was no hand washing instructions near the hand washing places for both enterprise categories. Beside the absence of hand washing instructions, all enterprise categories did not have clear working rules and regulations regarding hygiene and sanitation posted on the walls in the enterprises. Bas *et al.* (2007) made similar observations in Turkey's food businesses but at least 29.6% had written standards operating procedures for cleaning and disinfection of equipment and facilities. Lack of proper hygiene facilities is a major concern for these enterprises. Sousa (2008) and Chaudhary (2005) consider personal facilities such as toilets, rest rooms, hand washing and drying facilities as indispensable in a food processing enterprise as well as both hot and cold water present in those facilities. In this regard, (CAC, 2003) recommended that there should be a male and a female washing rooms in addition to changing facilities for the personnel which should not open directly to the food processing or storage area.

#### 4.5.2 Hygiene of employees

The status of cleanliness of workers in the surveyed enterprises is shown in Table 10. The results show that there was significant relationship between enterprise categories and availability of facilities such as laboratory coats, gloves, showers and a changing room for personnel. The majority of medium enterprises had these tools compared to only the minority of small enterprises. The results further indicate that 81.8% of the medium enterprises had laboratory coats compared to 31.2% with significant difference ( $p=0.01$ ). Similarly, 72.7 % of medium enterprises had gloves compared to 31.3% of the small enterprises again with significant difference ( $p=0.04$ ). Only 27.3% of the medium enterprises has changing room for personnel compared to 0% of the small enterprises ( $p=0.05$ ). In general, compliance to personnel hygiene requirement was more respected in medium than in small enterprises.

This unsatisfactory condition of the cleanliness of the employees in the studied processing enterprises may easily lead to contamination of processed products. Sousa (2008) considered the food as a true culture media for microorganisms in tropical conditions when the hygiene practices are not respected in food processing enterprises. It was established that the majority of the employees did not have a health certificate; this could be a danger to the food which may be prone to contamination when manufactured by a diseased worker who according to Eastern Research Group Inc. (2004) such worker should be excluded from manufacturing processes in case the disease can contaminate the foods. Therefore, it is of paramount that small and medium scale pineapple processors put much effort to improve the hygiene of the enterprises employees. This can be achieved by availing the necessary clothing and hygiene facilities to all food handlers in any food processing industry.

### 5. Conclusions and recommendations

Food safety has become a major public concern worldwide. Therefore, for small and medium scale pineapple food processing in Rwanda to enter the export market, there is a need of complying with international food safety standards regulations. However, the present study has reported none compliance with the requirements of GMP and GHP of the surveyed pineapple processing plants. The processing plants face the problem of having a proper processing plant in terms of general required plant and equipment type, layout and design for food processing companies. They also lack facilities such as regular clean water supply and electricity, washing and changing rooms for workers. This situation of working under unhygienic environment and poor personal hygiene could lead to the production of unsafe processed pineapple products. Therefore, small and medium pineapple processing enterprises should seek information regarding the hygienic requirements of the export market in the Rwanda Bureau of Standards. Also other development government and non-government institutions should assist these enterprises by informing and training them on the requirements and implementation of export market requirements in terms of GMP and GHP. Failing to do this, will restrict processed products to local market only but also pose health hazard to consumers.

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Table 1. Status of food processing enterprises buildings

Compliance criteria	Medium enterprises % (n)	Small enterprises % (n)	Fischer's Exact Test
Mud house	0 (0)	18.8 (3)	0.19
House made of brick and cement	100 (11)	81.8 (13)	
Roof made of grass thatch	18.2 (2)	6.2 (1)	0.35
Roof made of iron sheets	81.8 (9)	93.8 (15)	
Floor cemented	90.9 (10)	93.8 (15)	0.6
Floor tiled	9.1 (1)	6.2 (1)	
Wall painted with water paint	45.5 (5)	56.2 (9)	0.32
Wall painted with oil paint	36.4 (4)	12.5 (2)	
Wall is not painted	18.1(2)	31.3 (5)	



Table 2. Compliance of small and medium scale enterprises to selected premises design parameters

Compliance criteria	Medium enterprises % (n)	Small enterprises % (n)	Fischer's exact Test
Availability of a reserved area where pineapples are washed			
Yes	63.6 (7)	37.5 (6)	0.18
No	36.4 (4)	62.5 (10)	
Piped cold water in the reserved area for washing pineapples			
Yes	28.6 (2)	33.3 (2)	0.80
No	71.4 (5)	66.7 (4)	
Piped hot water in that place in the reserved area for washing pineapples			
Yes	0.0 (0)	0.0 (0)	-
No	100.0 (7)	100.0 (6)	
Placed designed to be easily cleanable			
Yes	57.1 (4)	66.7 (4)	0.72
No	42.9 (3)	33.3 (2)	
Availability of a reserved area for only processing			
Yes	81.8 (9)	75.0 (12)	0.34
No	18.2 (2)	25.0 (4)	
Processing area restricted or controlled			
Yes	45.5 (5)	25.0 (4)	0.26
No	54.5 (6)	75.0 (12)	
Availability of a reserved area for only filling			
Yes	90.9 (10)	68.8 (11)	0.17
No	19.1 (1)	31.2 (5)	
Availability of a reserved area for only capping			
Yes	81.8 (9)	62.5 (10)	0.28
No	18.2 (2)	37.5 (6)	
Availability of a reserved area for only packaging			
Yes	72.7 (8)	62.5 (10)	0.58
No	22.3 (3)	37.5 (6)	
Availability of a reserved area for storage of finished products			
Yes	81.8 (9)	75.0 (12)	0.65
No	28.2 (2)	25.0 (4)	
Availability of a reserved area for only storage of raw material			
Yes	81.8 (9)	50.0 (8)	0.09
No	28.2 (2)	50.0 (8)	
Score the cleanliness of the storage room			
Satisfactory	33.3 (3)	12.5 (1)	0.56
Acceptable	22.2 (2)	37.5 (3)	

Not satisfactory	44.4 (4)	50.0 (4)	
Absent (not clean at all)	-	-	
Number of entry doors available			
One doors	27.3 (3)	18.8 (3)	0.60
Two doors	72.7 (8)	82.2 (13)	
Clean sector separated with unclean sector			
Yes	63.6 (7)	31.2 (5)	0.09
No	36.4 (4)	68.8 (11)	
Crisscross of production line			
Yes	81.8 (9)	87.5 (14)	0.68
No	18.2 (2)	12.5 (2)	

Table 3. Ventilation and lighting requirements of the food processing working rooms

Compliance criteria	Observation	Medium enterprises % (n)	Small enterprises % (n)	Fischer's exact Test
Availability of the ventilation system in the processing plant	Yes	100.0(11)	93.8 (15)	0.39
	No	0.0 (0)	6.2 (1)	
Type of ventilation	Natural ventilation	100.0 (11)	100.0 (16)	-
Neutrality of the light in the working rooms	Satisfactory	9.1 (1)	25.0 (4)	0.22
	Acceptable	18.2 (2)	6.2 (1)	
	Not satisfactory	72.7 (8)	50.0 (8)	
	Absent	0 (0)	18.3 (3)	
Brightness of the working rooms	Satisfactory	18.3 (2)	25.0 (4)	0.14
	Acceptable	36.2 (4)	6.2 (1)	
	Not satisfactory	45.5 (5)	50.0 (8)	
	Absent	0.0 (0)	18.8 (3)	

Table 4. Cleanliness of the enterprise surrounding areas

Compliance criteria	Observation	Medium enterprises % (n)	Small enterprises % (n)	Fischer's Exact Test
Availability of a cleaning plan of the building and surrounding area	Yes	9.1 (1)	12.5 (2)	0.78
	No	90.0 (10)	87.5 (14)	
Control of the cleanliness of the processing enterprise surroundings	Yes	100 (11)	75.0 (12)	0.07
	No	0.0 (0)	25.0 (4)	
Score of the cleanliness of the building and surrounding areas	Satisfactory	9.0 (1)	12.5 (2)	0.29
	Acceptable	45.5 (5)	18.8 (3)	
	Not satisfactory	45.5 (5)	50.8 (8)	
	Absent	0.0 (0)	18.8 (3)	

Table 5. Status of the cleanliness of the processing rooms

Compliance criteria	Medium enterprises % (n)	Small enterprises% (n)	Fischer's Exact test
Score of the smoothness of the walls			
Satisfactory	18.2 (2)	25.0 (4)	0.01
Acceptable	63.6 (7)	6.2 (1)	
Not satisfactory	18.2 (2)	50.0 (8)	
Absent	0.0 (0)	18.8 (3)	
Score of the color of the walls			
Satisfactory	18.2 (2)	25.0 (4)	0.14
Acceptable	36.4 (4)	6.2 (1)	
Not satisfactory	45.5 (5)	50.0 (8)	
Absent	0.0 (0)	18.8 (3)	
Score of the washability of the walls			
Satisfactory	0.0 (0)	6.2 (1)	0.11
Acceptable	36.4 (4)	6.2 (1)	
Not satisfactory	63.6 (7)	68.8 (11)	
Absent	0.0 (0)	18.8 (3)	
Cracks present in the walls			
Yes	18.2 (2)	62.5 (10)	0.02
No	81.8 (9)	37.5 (6)	
Score of the smoothness of the floor			
Satisfactory	45.5 (5)	18.8 (3)	0.02
Acceptable	45.5 (5)	12.5 (2)	
Not satisfactory	9.1 (1)	50.0 (8)	
Absent	0 (0)	18.8 (3)	
Score of the washability of the floor			
Satisfactory	36.4(4)	20.0 (3)	0.08
Acceptable	45.5 (5)	13.3 (2)	
Not satisfactory	18.2 (2)	46.7 (8)	
Absent	0 (0)	20.0 (3)	
Floor made of water resistant material			
Satisfactory	27.3 (3)	25.0 (4)	0.06
Acceptable	54.5 (6)	12.5 (2)	
Not satisfactory	18.2 (2)	43.8 (7)	
Absent	0.0 (0)	18.8 (3)	
Cracks present at the floor			
Yes	36.4 (4)	68.8 (11)	0.09
No	63.6 (7)	31.2 (5)	
Score of the lights of the ceiling			
Satisfactory	18.2 (2)	25.0 (4)	0.14

Acceptable	36.4 (4)	6.2 (1)	
Not satisfactory	38.5 (5)	61.5 (8)	
Absent	0.0 (0)	18.8 (3)	
Score of the washability of the ceiling			
Satisfactory	18.2 (2)	18.8 (3)	0.26
Acceptable	27.3 (3)	6.2 (1)	
Not satisfactory	54.5 (6)	56.3 (9)	
Absent	0.0 (0)	18.7 (3)	
Score of the smoothness of the ceiling			
Satisfactory	9.0 (1)	6.2 (1)	0.05
Acceptable	45.5 (5)	25.0 (4)	
Not satisfactory	45.5 (5)	50 (8)	
Absent	0.0 (0)	18.8 (3)	
Cracks present in the ceiling			
Yes	27.3 (3)	68.8 (11)	0.04
No	72.7 (8)	31.2 (5)	

Table 6. Status of the cleanliness of the equipment used in the enterprises

Compliance criteria	Observation	Medium enterprises % (n)	Small enterprises % (n)	Fischer's Exact test
Equipment providing time and temperature control	Yes	9.1 (1)	3.7 (1)	0.21
	No	90.9 (10)	96.3 (15)	
Equipment cleaned	Yes	90.9 (10)	75 (12)	0.29
	No	9.1 (1)	25 (4)	
Cleanliness of the equipment	Satisfactory	9.1 (1)	12.5 (2)	0.24
	Acceptable	72.7 (8)	37.5 (6)	
	Non satisfactory	18.2 (2)	31.2 (5)	
	Absent (Not clean at all)	0.0 (0)	18.8 (3)	
Maintenance of the equipment	Satisfactory	18.1 (2)	6.2 (1)	0.36
	Acceptable	36.4 (4)	25.0 (4)	
	Non satisfactory	45.5 (5)	50.0 (8)	
	Absent (Not maintained at all)	0.0 (0)	18.8 (3)	
Smoothness of the equipment	Satisfactory	9.1 (1)	12.5 (2)	0.03
	Acceptable	63.6 (7)	12.5 (2)	
	Non satisfactory	27.3 (3)	56.2 (9)	
	Absent (Not clean at all)	0.0 (0)	18.8 (3)	
Number of times other utensils are cleaned	Everyday	72.7 (8)	12.5 (2)	0.00
	Once a week	0 (0)	6.2 (1)	
	Every time we do processing	27.3 (3)	81.2 (13)	
Equipment subject to rot	Yes	18.2 (2)	62.5 (10)	0.02
	No	81.8 (9)	37.5 (6)	

Table7. Status of the work surface and furniture for medium and small enterprises

Compliance criteria	Medium enterprises % (n)	Small enterprises % (n)	Fischer's Exact test
Material in which working surface are made			0.66
Wooden	36.4 (4)	50.0 (8)	
Plastic	9.1 (1)	6.2 (1)	
Aluminium	45.5 (5)	25.0 (4)	
Stainless steel	9.0 (1)	18.8 (3)	
Smoothness of work surfaces			0.31
Satisfactory	18.1 (2)	6.2 (1)	
Acceptable	18.1 (2)	18.8 (3)	
Not satisfactory	63.6 (7)	50.0 (8)	
Absent	0.0 (0)	25.0 (4)	
Washability of the work-surfaces			0.35
Satisfactory	9.0 (1)	6.2 (1)	
Acceptable	27.4 (3)	18.8 (3)	
Not satisfactory	63.6 (7)	50.0 (8)	
Absent	0.0 (0)	25.0 (4)	
Resistance to water for work-surfaces			0.30
Satisfactory	9.0 (1)	6.2 (1)	
Acceptable	45.5 (5)	18.8 (3)	
Not satisfactory	45.5 (5)	50.0 (8)	
Absent	0.0 (0)	25.0 (4)	
Smoothness of the furniture			0.22
Satisfactory	9.0 (1)	6.2 (1)	
Acceptable	45.5 (5)	18.8 (3)	
Not satisfactory	45.5 (5)	50.0 (8)	
Absent	0.0 (0)	25.0 (4)	
Washability of the furniture			0.22
Satisfactory	9.0 (1)	6.2 (1)	
Acceptable	45.5 (5)	18.8 (3)	
Not satisfactory	45.5 (5)	50.0 (8)	
Absent	0.0 (0)	25.0 (4)	
Resistance to water for furniture			0.22
Satisfactory	9.0 (1)	6.2 (1)	
Acceptable	45.5 (5)	18.8 (3)	
Not satisfactory	45.5 (5)	50.0 (8)	
Absent	0.0 (0)	25.0 (4)	

Table 8. Management of waste at enterprise level

Compliance criteria	Observation	Medium enterprises % (n)	Small enterprises % (n)	Fischer's Exact test
Availability of a container for waste	Yes	100.0 (11)	93.8 (15)	0.39
	No	0.0 (0)	6.2 (1)	
Container being covered	Yes	0.0 (0)	6.7 (1)	0.38
	No	100.0 (11)	93.3 (15)	
Material in which the dustbin is made	Plastic	0.0 (0)	6.7 (1)	0.38
	Traditional	100.0 (11)	93.3 (15)	
Availability of a waste disposal system	Yes	100.0 (11)	100.0 (16)	-
Rooms having drainage that facilitates cleaning water to go out	Yes	9.1 9 (1)	0.0 (0)	0.21
	No	90.9 (10)	100.0 (16)	
Floors and walls joined with a round gorge assemblies	Yes	0.0 (0)	0.0 (0)	
	No	100.0 (11)	100.0 (16)	
Having an outside drainage	Yes	36.4 (4)	12.5 (2)	0.14
	No	63.6 (7)	87.5 (14)	
Stagnant water on the floors	Yes	36.4 (4)	18.8 (3)	0.30
	No	63.6 (7)	81.2 (13)	
Visible dust on the ground	Yes	9.1 (1)	25.0 (4)	0.29
	No	90.9 (10)	75.0 (12)	

Table 9. Insect control for both small and medium enterprises

Compliance criteria	Observation	Medium enterprises % (n)	Small enterprises % (n)	Fischer's exact test
Availability of an insect and pest control system	Yes	9.1 (1)	6.2 (1)	0.78
	No	90.9 (10)	93.8 (15)	
Processing machine placed against the walls of the building	Yes	0.0 (0)	31.2 (5)	0.07
	No	100.0 (11)	68.8 (11)	
Availability of mosquito net at windows	Yes	100.0 (11)	62.5 (11)	0.02
	No	0.0 (0)	37.5 (5)	
Material in which the window are made	Wooden	0.0 (0)	50.0 (8)	0.01
	Screen	63.6 (7)	43.8 (7)	
	Metal	36.4 (4)	6.2 (1)	
Material in which the doors are made	Wooden	9.1 (1)	50.0 (8)	0.03
	Screen	18.2 (2)	0.0 (0)	
	Metal	50.0 (8)	50.0 (8)	
Availability of a ventilation system in the processing plant	Yes	100.0 (11)	93.8 (15)	0.39
	No	0.0 (0)	6.2 (1)	
Type of ventilation	Natural ventilation	100.0 (11)	100.0 (16)	-

Table 10. Cleanliness of the workers for small and medium enterprises

Compliance criteria	Medium enterprises		Small enterprises		Fischer's Exact test
	Yes % (n)	No % (n)	Yes % (n)	No % (n)	
Workers wearing lab coat	81.8 (9)	18.2 (2)	31.2 (5)	68.8 (11)	0.01
Workers wearing gloves	72.7 (8)	27.3 (3)	31.3 (5)	68.7 (11)	0.04
Workers wearing working choose	72.7 (8)	27.3 (3)	18.8 (3)	81.2 (13)	0.08
Workers cutting their finger nails	72.7 (8)	27.3 (3)	37.5 (6)	62.5 (10)	0.07
Changing room for personnel	27.3 (3)	72.7 (8)	0.0 (0)	100.0 (16)	0.05
The availability of cleaning chemicals	100.0 (11)	0.0 (0)	75.0 (12)	25 (4)	0.07
Workers disposing of health certificates	36.4 (4)	63.6 (7)	12.5 (2)	87.5 (14)	0.14
Workers disposing health insurances	100 (11)	0.0 (0)	93.8 (15)	6.2 (1)	0.39



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