

Barriers Hindering the Development and Implementation of Verification Programmes at Some Selected Pineapple Juice Processing Companies in Ghana

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Abstract. Quality assurance measures during fruit juice production include verification of hygiene and temperature control to assure that microbiological contamination and proliferation are limited. However, most food companies in Ghana do not have adequate quality assurance systems. Bottlenecks that served as barriers to the development and implementation of verification programs in some selected pineapple juice processing companies were identified. Personal interviews and structured questionnaires used in data collection for four case studies revealed barriers as lack of high management commitment, lack of adequate resources and lack of adequate technical and scientific information.

Keywords: Quality management system, Verification programs, Quality assurance

1. Introduction

Pineapple juice is a common and highly patronised product on the Ghanaian market. Despite its nutritional benefits, a lot of microorganisms have been associated with fresh fruit juices with fermentative yeasts and lactic acid bacteria being the major spoilage organisms [1]-[3]. An effective Food Quality Management System (FQMS) has to be in place to ensure that processing takes place under controlled conditions and that the end-product is of the highest quality in terms of safety and shelf life. Quality assurance (QA) activities are some of the activities that make up a FQMS. Quality assurance is all the planned and systematic actions which are aimed at ensuring and providing confidence that production processes function as required and subsequently assuring the quality of the end product [4], [5]. Quality assurance activities include validation, verification and auditing [5]. It is recommended that verification activities have to be carried out on each process within all programs that have an influence on the food safety/quality of the end-product [6].

Despite the obvious positive impact of FQMSs, some authors have observed that food companies that produced for the Ghanaian domestic market did not have FQMS in place and thought it was unnecessary to comply with stringent international requirements for food quality [7]. In order to develop interventions to support pineapple juice processing companies in the development, implementation and maintenance of verification programs as part of a FQMS, there is the need to identify the factors which prevent these companies from having proper verification programs in their companies. The purpose of this study was therefore to identify the barriers which prevent pineapple juice processing companies from having operational verification programs.

2. Methodology

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2.1. Development of Research Instrument

In order to have a reference situation with which data obtained from the companies could be compared, various literatures were used to develop a research instrument as detailed in Table 1.

Table 1. Research instrument

Factor which hinders the development and implementation of verification programs	Reference situations
Adequacy of training [7]-[10].	<ul style="list-style-type: none"> Level 3 (Adequate) – Practical, theoretical, formal, in-house and specific for the pineapple juice processing companies. Focuses on the principles of the QA standard/guideline, technical and technological information like identification of hazards, sources of microbial or chemical contamination and product parameters or process conditions that can limit these contaminations. Level 2 (Semi-adequate) – In-house, formal, theoretical but not specific for pineapple juice processing companies. Focuses on the principles of the QA standard/guideline, technical and technological information like identification of hazards, sources of microbial or chemical contamination and product parameters or process conditions that can limit these contaminations. Level 1 (Inadequate) – In-house, practical and may be specific to the pineapple juice processing companies. Focuses on only technical and technological information concerning the processing of fruit juice.
Adequacy of personnel knowledge [5],[8],[9],[11]	<ul style="list-style-type: none"> Level 3 (Adequate) – Knowledge about: the application of QA (HACCP) principles, setting and verifying CCPs and critical limits; all possible sources of yeast contamination during processing; nature, formulation and processing conditions of the fruit juice; factors during processing activities that will enable an increase or decrease in the number of microorganisms in the final product; implications of the presence of microorganisms to food quality. Level 2 (Semi-adequate) – Despite the kind of knowledge that the QA personnel have, they should have at least knowledge about how to apply QA principles, HACCP, setting and verifying CCPs and critical limits, factors during processing activities that will enable an increase or decrease in the number of microorganisms in the final juice product. Level 1 (Inadequate) – Despite the kind of knowledge that the QA personnel have, they do not have knowledge about how to apply QA principles, HACCP, setting and verifying CCPs and critical limits.
Extent of management commitment [5],[12],[13]	<ul style="list-style-type: none"> Level 3 (High) – Establishment of quality policy and provision of all needed resources together with other things like training, attending meetings, etc. Level 2 (Medium) – Provision of all needed resources but no establishment of quality policy. Other things like training and attendance to meetings are encouraged by management. Level 1 (Low) – Provision of some or no needed resources and presence or absence of quality policy even though management may encourage other things like training and attendance to meetings.
Availability of technical and scientific information [12],[14],[15]	<ul style="list-style-type: none"> Level 3 (Highly Available) – Easily available reference literature that considers the peculiar production characteristics of the company for the development of the verification program, food-borne disease surveillance records, records on national food poisoning statistics and records on biological hazards. Level 2 (Semi-available) – No matter what is easily available, there should also be available reference literature that considers the peculiar production characteristics of the company for the development of the verification program. Level 1 (Poorly available) – No matter what is easily available, reference literature that considers the peculiar production characteristics of the company for the development of the verification program is not available.
Availability of resources [7],[12],[16]	<ul style="list-style-type: none"> Level 3 (Highly available) – Accredited laboratories or easy access to laboratories, well-maintained equipment for verification and monitoring activities are available. Level 2 (Semi-available) – Accredited laboratories or easy access to laboratories, monitoring equipment are available. Level 1 (Poorly available) – Only monitoring equipment are available.

2.2. Case Selection and Data Collection

The multiple case study method was chosen for this research in order to give more convincing evidence for the data collected. The multiple case study increases confidence in the results obtained through replication and comparisons of the same phenomena among cases to establish patterns [17]. During the sampling of cases, members of the Fruit Processors and Marketers Association of Ghana were obtained from the official website of the association (<http://fpmag.org/4/Member-Companies>). The companies which were located in Accra were contacted by telephone to find out the ones which produced pineapple juice. Twelve pineapple juice processing companies were randomly chosen to participate in the case study after either a visit to their companies, or an extensive telephone conversation detailing the research being conducted. However, only four companies agreed to participate fully in the research. The cases under study were therefore four pineapple juice processing companies in Accra, Ghana (Companies A, B, C and D). The phenomenon was the factors which influenced the development and implementation of verification programs at their companies. All the cases were studied individually with the use of the same methods for collecting data. The methods of data collection were semi-structured interviews and questionnaires. Each company was visited twice, initially for a background study and secondly to collect data for the phenomenon under study.

None of the cases had an operational verification program for any of the unit processes during pineapple juice production.

All the companies are privately owned by Ghanaians except company D which is privately owned by a Lebanese. None of the companies export their products; they all target local consumers. The characteristics of the companies are presented in Table 2.

Table 2. Characteristics of companies used as cases in the study

Company	Number of years in operation	Number of employees	Volume of pineapple juice produced (l/day)
Company A	7	40	1358
Company B	3	23	1440
Company C	18	25	1455
Company D	19	45	2100

3. Results

The statuses of factors which hindered the companies from having operational verification programs for pineapple juice processing are shown in Table 3.

Table 3. Status of the factors which hinder the development and implementation of verification programs at Companies A, B, C and D.

Factor	Status of the factor			
	Company A	Company B	Company C	Company D
Availability of resources	2	2	3	1
Adequacy of QA personnel training	3	3	3	1
Adequacy of QA personnel knowledge	3	1	1	1
Extent of management commitment	1	1	2	1
Extent of enforcement of governmental regulations	2	2	2	1
Availability of technical and scientific information	2	2	1	1

Legend: 1 – Poor, low or inadequate; 2 – semi or medium; 3 – adequate or high

At Companies A, B and C, the training given to the person in charge of quality matters was practical and theoretical, formal and in-house. The training also focused on the principles of the QA standard/guideline, technical and technological information like identification of hazards, sources of microbial or chemical contamination and product parameters or process conditions that can limit these contaminations. Training was specific for the pineapple juice processing companies. Therefore the adequacy of training of QA personnel at those companies was found to be at level 3 (Table 3). At Company D, the training given to the person in charge of quality matters was only in-house and practical. The training only focused on technical information that pertains to the production process. The adequacy of the QA personnel training at Company D was found to be at level 1 (Table 3).

The person in charge of quality matters at company A had knowledge about how to apply the principles of the QA standard, all possible sources of yeast contamination during processing and the factors that would enable an increase or decrease in the number of microorganisms in the fruit juice during the production processes. He also had knowledge about the nature, formulation and processing conditions of the fruit juice as well as the implications of the presence of microorganisms to food quality. The adequacy of the knowledge of the person in charge of quality matters at Company A was therefore found to be at level 3 (Table 3). At Company B, the person in charge of quality matters had knowledge about the possible sources

of yeast contamination during pineapple juice processing and the nature, formulation as well as the processing conditions of the fruit juice. However, he had no knowledge of how to apply QA principles, HACCP, setting and verifying CCPs and critical limits as well as the factors that would enable an increase or decrease in the number of microorganisms during processing. He also did not have knowledge about the implications of microorganisms to food quality. The adequacy of his knowledge was therefore found to be at level 1 (Table 3). An inadequate knowledge level (Table 3) was found for the person in charge of quality matters at Company C. He had knowledge about the possible sources of yeast contamination, the implications of microorganisms to food quality as well as the nature, formulation and processing condition of the pineapple juice. However, he had no knowledge of how to apply QA principles, HACCP, setting and verifying CCPs and critical limits as well as the factors that would enable an increase or decrease in the number of microorganisms in the final juice product. The adequacy of knowledge of the person in charge of quality matters at Company D was found to be at level 1 (Table 3). This is because he had knowledge about only the nature, formulation and processing condition of the pineapple juice. He had no knowledge of how to apply QA principles, HACCP, setting and verifying CCPs and critical limits, the possible sources of yeast contamination, the implications of microorganisms to food quality as well as the factors that would enable an increase or decrease in the number of microorganisms during processing.

At Company A, there was a quality policy which had been established by management but they did not provide all the needed resources. Management at Company A also trained workers and made follow-up assessments after training to ensure that workers understood the program. The extent of management commitment was however found to be at level 1 (Table 3) at Company A. There was an established quality policy and some needed resources were provided by management at Company B. Management of Company B trained workers and made follow-up assessments after training to ensure that workers understood the program. Therefore, the extent of management commitment at Company B was found to be at level 1 (Table 3). At Company C, management provided all needed resources but had not established a quality policy. The extent of management commitment at Company C was therefore found to be at level 2 (Table 3). The management of Company D neither provided all the needed resources nor was there a quality policy in the company. The extent of management commitment was therefore found to be at level 1 (Table 3) for company D.

At companies A, B and C, there were inspections done by governmental authorities at least once a year but they were not penalised for not having the required documentation for the pasteurisation and sanitation processes. Therefore the extent of governmental enforcement of regulations for those companies was at Level 2 (Table 3). At Company D, governmental inspections had not been done for over seven years and they were also not penalised for non-compliance to regulations. Microbiological analyses had not been conducted on end-products by Company D for the past seven years but its products were trading successfully on the Ghanaian market. Therefore the extent of governmental enforcement of regulations at Company D was at Level 1 (Table 3).

Reference literature that considers the peculiar production characteristics of the company for the development of the verification program were the only scientific and technical information available to companies A and B. Company A had easy access to this information and they used the internet and personal communication with their peers to that information. Company B had easy access to scientists which they used as their source of information for reference literature for the development of the verification programs during pineapple juice processing. Company C had easy access to the internet which they used to access scientific and technical information relating to new product development and biological hazards. Company D had no access to any scientific and technical information. The availability of technical and scientific information for Company A and B were at level 2 (Table 3), and Company C and D were at level 1 (Table 3).

Company A had easy access to external accredited laboratories but no equipment (resources) for verification. Some user-friendly monitoring equipment were also available. The availability of resources was at level 2 (Table 3) at Company A. At Company B, there were no verification equipment, but monitoring equipment were available and user-friendly. The company had easy access to external accredited laboratories. The availability of resources was at level 2 (Table 3). At Company C, equipment for verification and monitoring activities were available, well-maintained and user-friendly. The company had easy access to

external accredited laboratories. The availability of resources was at level 3 (Table 3). Company D neither had laboratories nor used any external laboratories. No laboratory tests were done on any of their products. Verification equipment were also unavailable but monitoring equipment were available and user-friendly. The availability of resources was at level 1 (Table 3).

4. Discussion and Conclusion

Various reasons have been given for the lack of or inadequate quality management systems in food processing companies amongst which poor management commitment has been cited as the most important reason [13], [18]. In this study, management commitment was found to be low in three companies and medium in one. The findings in this study suggest a consistency with the conclusions made by those authors.

Developing countries face a lot of difficulties in obtaining scientific and technical information for the development, implementation and maintenance of quality systems [14]. This was confirmed in this study because technical and scientific information were semi available to two companies and poorly available to the other two companies (Table 3). Inadequate sources relating to quality systems has also been identified as a hindering factor in the development of food quality management systems [18], [19]. Restricted access to reliable information concerning quality systems from the government has also been cited as a factor that influenced the development, implementation and maintenance of quality systems [20]. In Ghana, there are no on-going programmes by the government for assisting the food industry in QMSs as well as training in HACCP but other quality assurance practices are only provided when the food companies make a request for it [21]. None of the cases studied obtained technical and scientific information from the government. It is therefore not surprising that none of the companies had any operational verification program.

Despite the adequate training given to the person responsible for quality matters at companies B and C, they had inadequate knowledge. Actual knowledge acquisition i.e. the extent to which trainees know more after any form of training can be used to measure the effectiveness of training [22]. This implies that training that was given to the people in charge of quality matters at companies B and C, though adequate was not effective in improving their knowledge. Considering the data collection method used, it is possible that the person in charge of quality matters at those companies did not provide accurate information concerning the adequacy of training given to them. There was no means of verifying this information because training records were not available. A lack of knowledge about QMS has been identified as one of the main barriers to developing and implementing QMS [19], [23]. However, this cannot be said about the pineapple juice processing companies in Ghana because eventhough one company has a QA manager who had received adequate training and had adequate knowledge (Table 3), there was no documented and operational verification program at that company.

Some authors have indicated that lack of infrastructure and equipment was hindering the development and implementation of quality assurance programs in food industries [7], [19], [23]. However, findings from this research indicated otherwise because eventhough at one company resources were highly available, there was no operational verification program there.

The Ghanaian laws require food processing companies to comply with current codes of good manufacturing practices (GMP) [24]. Proper documentation is an important aspect of GMP. However, the companies studied did not have adequate documentation covering the sanitation and pasteurisation processes which are considered important processes for the reduction and elimination of microorganisms in the pineapple juice. A study found out that the laws in Ghana were not properly enforced because regulatory officials were not conducting frequent inspections and even companies which had not been inspected and had not received certification to market their products from regulatory officials were offering their products for sale on the Ghanaian market [7]. However in this study, findings indicate that regulatory inspections were frequent at three companies (A, B and C). These inspections by the regulatory officials were not conducted via document analyses of production parameters but actual observation of the production process and checking microbiological test reports from laboratories. It has also been observed that there are inconsistencies and lack of enthusiasm in enforcement actions by regulatory authorities [7]. This statement was found to be true in this study when one of the companies (Company D) was using only governmental regulation and even had certification from them but was not adhering to the requirements of the

governmental regulation even to the extent of not conducting any microbiological tests on the end-product before offering the juice for sale on the Ghanaian market. Regulatory inspections had not been done at Company D for the past seven years. Eventhough there were inspections and audits at Companies A, B and C, there were no penalties meted out to them for non-compliance to the national regulations concerning having proper documentation for GMPs.

In conclusion, as per the research instrument and references, the factors that are deemed crucial for the development and implementation of verification programs during pineapple juice processing in Ghana are the extent of support that the government gives to companies, extent of management commitment and the availability of technical and scientific information.

5. References

- [1] J.T. Tchang, R. Tailliez, P. Eb, T. Njine and J.P. Hornez. Heat resistance of the spoilage yeasts *Candida pelliculosa* and *Kloeckera apis* and pasteurization values for some tropical fruit juices and nectars. *Food Microbiology*. 1997, 14: 93–99.
- [2] K.S. Ghenghesh, K. Belhaj, W.B. El-Amin, S.E. El-Nefathi and A. Zalmum. Microbiological quality of fruit juices sold in Tripoli–Libya. *Food Control*. 2005, 16 (10): 855–858.
- [3] M.E. Parish. Food safety issues and the microbiology of fruit beverages and bottled water. In: N. Heredia *et al.* (eds.). *Microbiologically Safe Foods*. John Wiley & Sons Inc., 2009, Ch 13.
- [4] J.A. Vasconcellos. *Quality Assurance for the Food Industry: A Practical Approach*. CRC Press, 2004, Ch 2,3.
- [5] P.A. Luning W.J. and Marcelis. *Food Quality Management; Technological and Managerial Principles and Practices*. Wageningen Academic Publishers, 2009, Ch 7.
- [6] K.P.E. Keener. Verification programs, Safe food guidelines for small meat and poultry processors. Purdue Extension, 2007. Available at <http://www.extension.purdue.edu/extmedia/FS/FS-24-W.pdf>. Last visited on 02/11/2012.
- [7] L.D. Mensah and D. Julien. Enhancing Access to the Global Food Manufacturing Value Chain: The Role of a Food Safety Technical Regulation in Ghana. *Journal of International Food & Agribusiness Marketing*. 2011, 23 (3): 247-270.
- [8] T. Mayes. HACCP Training. *Food Control*. 1994, 5 (3): 190-195.
- [9] G. Moy, F. Ktiferstein and Y. Motarjemi. Application of HACCP to food manufacturing: some considerations on harmonization through training. *Food Control*. 1994, 5 (3): 131-139.
- [10] K. Nguz. Assessing food safety system in sub-Saharan countries: An overview of key issues. *Food Control*. 2007, 18: 131–134.
- [11] C.A. Wallace, L. Holyoak, S.C. Powell and F.C. Dykes. Re-thinking the HACCP team: An investigation into HACCP team knowledge and decision-making for successful HACCP development. *Food Research International*. 2012, 47: 236–245.
- [12] P.J. Panisello and P.C. Quantick. Technical barriers to Hazard Analysis Critical Control Point (HACCP). *Food Control*. 2001, 12 (3): 165–173.
- [13] A. Wilcock, B. Ball and A. Fajumo. (2011). Effective implementation of food safety initiatives: Managers', food safety coordinators' and production workers' perspectives. *Food Control*. 2011, 22 (1): 27–33.
- [14] P. Jirathana. Constraints Experienced by Developing Countries in the Development and Application of HACCP. *Food Control*. 1998, 9: 91–100.
- [15] M.P.V. Azanza and M.B.V. Zamora-Luna. Barriers of HACCP team members to guideline adherence. *Food Control*. 2005, 16: 15–22.
- [16] B. Ball, A. Wilcock and M. Aung. Factors influencing workers to follow food safety management systems in meat plants in Ontario, Canada. *International Journal of Environmental Health Research*. 2009, 19 (3): 201-218.
- [17] W. Tellis. Introduction to Case Study. *The Qualitative Report*. 1997, 3 (2). Available at <http://www.nova.edu/ssss/QR/QR3-2/tellis1.html>. Last visited on 13/05/2013.
- [18] P. Arpanutud, S. Keeratipibul, A. Charoensupaya and E. Taylor. Factors influencing food safety management

system adoption in Thai food-manufacturing firms: Model development and testing. *British Food Journal*. 2009, 111 (4): 364 – 375.

- [19] M. Baş, M Yüksel, and T. Çavuşoğlu. Difficulties and barriers for the implementing of HACCP and food safety systems in food businesses in Turkey. *Food Control*. 2007, 18 (2): 124–130.
- [20] M. Ramnauth, F. Driver and P.B. Vial. Food safety management in the fish industry in Mauritius: knowledge, attitude and perception. *British Food Journal*. 2008, 110 (10): 989 – 1005.
- [21] FAO/WHO National Food Safety Systems in Africa – A Situation Analysis. *Regional Conference on Food Safety for Africa*. 2005, Harare, Zimbabwe.
- [22] P. Seaman. Food hygiene training: Introducing the food hygiene training model. *Food Control*. 2010, 21 (4): 381-387.
- [23] C.V. Fotopoulos, D.P. Kafetzopoulos, E.L. Psomas. Assessing the critical factors and their impact on the effective implementation of a food safety management system. *International Journal of Quality and Reliability Management*. 2009, 26 (9): 894 – 910.
- [24] Act 851. Ghana Public Health Act, *Part 7*. 2012.