PROCEEDINGS

2015 3rd International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

ICAIA 2015

August 3rd - 4th, 2015
IPB International Convention Center
Bogor, Indonesia

ISBN : 978-1-4673-7404-0
IEEE Catalog Number : CFP15C67-CDR

IEEE
INDONESIA SECTION

Proceedings of

2015 3rd International Conference on

Adaptive and Intelligent Agroindustry (ICAIA)

IPB International Convention Center, Bogor, Indonesia

August 3rd – 4th, 2015

Published by :

Department of Agroindustrial Technology

Bogor Agricultural University

Bogor, Indonesia

Welcome Message from The General Chairs of ICAIA 2015

On behalf of the organizing committee, it is our pleasure to welcome you to International Conference on Adaptive and Intelligent Agroindustry, Bogor, Indonesia. This is the 3rd conference on the topic that is held by the Department of Agroindustrial Technology, Bogor Agricultural University, Indonesia.

The conference is expected to provide excellent opportunity to meet experts, to exchange information, and to strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry. In addition, the conference committee invited five renowned keynote speakers, i.e. Prof Irawadi from Bogor Agricultural University; Prof Kenneth De Jong from George Mason University, USA; Dr Yandra Arkeman from Bogor Agricultural University; and Dr Guillermo Baigorria from University of Nebraska-Lincoln, USA.

The conference committee also invited Prof Noel Lindsay from University of Adelaide, Australia; Kiyotada Hayashi from National Agricultural Research Center-Tsukuba, Japan; Prof Margareth Gfrerer from Islamic State University of Jakarta, Indonesia; Dr Barry Elsey from University of Adelaide, Australia; Dr Gajendran Kandasamy from Melbourne University, Autralia; and Imperial College London-British, Prof Allan O'Connor from University of Adelaide, Australia; Dr Wisnu Ananta Kusuma from Bogor Agricultural University ,Indonesia; and Dr Frank Neumann from University of Adelaide, Australia, as invited speakers.

This conference was organized by Department of Agroindustrial Technology, Bogor Agricultural University and Asosiasi Agroindustri Indonesia, and technically sponsored by IEEE Indonesia Section. Furthermore, it was supported by Departement of Computer Science, Bogor Agricultural University; Surfactant amd Bionegergy Research Center; PT Bogor Life Science and Technology; Indonesian Ministry of Industry; PT Pachira Distrinusa; and PT Kelola Mina Laut.

I would like to take this opportunity to express my deep appreciation to the conference's committee members for their hard work and contribution throughout this conference. I would like to thank authors, reviewers, speakers, and session chairs for their support to participate in the Conference. Lastly, I would like to welcome you to join ICAIA 2015 and wish you all an enjoyable stay in Bogor.

Sincerely,
Dr Yandra Arkeman
General Chairs, ICAIA 2015

WELCOMING ADDRESS

Prof. Dr. Ir. Nastiti Siswi Indrasti
Head of Agroindustrial Technology Department
Faculty of Agricultural Engineering and Technology
Bogor Agricultural University

on

3rd International Conference on Adaptive and Intelligence Agroindustry (3rd ICAIA)

Bogor, August, 3 – 4, 2015

Assalamu'alaikum Warohmatullahi Wabarokatuh
In the name of Allah, the beneficent and the merciful,

Distinguish Guest, Ladies and Gentlemen
Let me first thank you all for accepting the invitation to participate in this 3rd International Conference on Adaptive and Intelligence Agroindustry (ICAIA). In particular I would like to thank Rector of IPB (Institut Pertanian Bogor/Bogor Agricultural University) Prof. Herry Suhardiyanto for supporting this event as part of the series academic event in celebrating the 52nd Anniversary of Bogor Agricultural University.

We are certainly proud to have been able to assemble this event in IPB, Bogor. The range of participants and audience at this conference is precisely something I would like to stress. Participants who followed the event more than 150 people, coming from various countries including the USA, Australia, Japan, Vietnam, Philippine, Germany and Indonesia. The main goal of the conference is to provide an effective forum for distinguished speakers, academicians, professional and practitioners coming from universities, research institutions, government agencies and industries to share or exchange their ideas, experience and recent progress in Adaptive and Intelligent Agroindustry.

The 2015 3rd International Conference on Adaptive and Intelligent Agro-industry (ICAIA) is the third forum for the presentation of new advances and research results on various topics in all aspects of innovative agro-industry that highlights the development and improvement for today and tomorrow's global need for food, energy, water and medicine. The aim of the conference is to stimulate interaction and cohesiveness among researchers in the vast areas of innovative agro-industry. Innovative Agro-industry has the ability to adapt intelligently to future global challenges, i.e. food, energy, water, and medical. Global challenges needs a new breed of Agroindustry which could produce innovative products to fulfill the needs through advanced processing technology, production systems and business strategy supported by cutting-edge information and communication technology.

The topic for this event is "Empowering Innovative Agroindustry for Natural Resources, Bioenergy and Food Sovereignty". The topics clustered into four main parts:
Track 1 : Innovative Agroindustrial and Business System Engineering

Track 2 : Frontier Approaches in Process and Bioprocess Engineering
Track 3 : Frontier Approaches in Industrial Environmental Engineering
Track 4 : Intelligent Information and Communication Technology for Adaptive Agroindustry of the Future

This event also hosts four (4) workshops: (1) Strategies for Agroindustry Development (2) LCA for Agroindustry (3) Innovation and Technopreneurship for Agroindustry and (4) Agroindustry Informatics.

Distinguish Guest, Ladies and Gentlement,
Agroindustry transforms agricultural commodities into high value-added products. Agroindustry is industry that process agricultural products to increase their value added significantly by using technology and by considering environmental aspect and sustainability. However, with changing global demand and technology advancement, innovative agroindustry is needed in order to be competitive as well as sustainable. The challenge of future agroindustry is not merely efficiency and productivity anymore, but also the challenge to appropriately apply frontier technology as well as meeting future global demands.

Agroindustry needs to deal with the application of advance technologies and cope future global issues. Current global issues which arise and expected to exist in the future are food sovereignty, renewable energy, sustainable water management and pharmacy. The ability of agro-industry to respond the future global issues and the undoubtedly substantial increase in demand in future decades will be highly dependent on the increased application of existing technologies as well as the exploitation of new and innovative technologies.

The emergence of high technology could be applied in the agro-industry are: nanotechnology, biotechnology, bioinformatics, food processing, food packaging-waste, state-of-the-art computation and many others. The aforementioned high-technology along with computation technology could greatly advance agro-industry from a traditional system into a smart-intelligent and innovative technology. Therefore, in the new millennia, adaptive-intelligent and innovative agro-industry will contribute to solutions to global problems and brings agriculture into perfection.

Hope this conference will also discuss this issue in more detail as it is an important matter for all of us. We should no more think just how to produce high value product but it is also necessarily important how to keep our live in good quality by understanding following old saying… “You do not live at once. You only die once and live every day”.

I do not to take up any more of your time with these opening remarks. Let me simply thank you once again for sharing your thoughts with us. Here’s wishing every success for the conference. May Allah bless all of us.

Thank you for your kind attention,
Wassalamu’alaikum Warohmatullahi Wabarokatuh

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AGENDA

Time	Activities
Monday, August 3rd 2015	
08.00 - 09.00	Registration
09.00 - 10.00	Opening Ceremony • Welcoming Address: Prof. Nastiti Siswi Indrasti (Head of DAT, Fateta, IPB) • Welcoming Speech Head of Bogor Regency • Conference Opening: Prof. Herry Suhardiyanto (Rector of IPB) • Opening Speech and Conference Opening : Minister of Industry Indonesia * • Launching Expose International program DAT
10.00 – 10.05	*Photo Session*
10.05 - 10.15	*Coffee break*
10.15 - 10.45 10. 45 - 11.30 11.30 – 12.00 12.00 – 12.30	Keynote Speech : 1. Prof Irawadi (Bogor Agricultural University, Indonesia) 2. Prof. Kenneth De Jong (George Mason University, USA) 3. Dr. Yandra Arkeman (Bogor Agricultural University, Indonesia) 4. Dr. Guillermo Baigorria (University of Nebraska, Lincoln, USA)
12.30 – 13.30	Lunch break
13.30 – 13.50 13.50 – 14.10 14.10 – 14.30 14.30 – 14.50 14.50 – 15.10 15.10 – 15.45	Plenary Session 1 : Prof. Noel Lindsay (University of Adelaide, Australia) Dr. Kiyotada Hayashi (National Agricultural Research Center, Tsukuba, Japan) Prof. Margareth Gfrerer (Islamic State University of Jakarta, Indonesia) Dr. Barry Elsey (University of Adelaide, Australia) Ir. M. Novi Saputra (Marketing Director KML Food Group) *Discussion*
15.30 – 15.45	*Coffee break*
15.45 – 18.00	Parallel session A, B and C
18.00 – 21.00	Welcome Dinner

Time	Activities
Tuesday, August 4rd 2015	
08.30 – 09.00	Registration
09.00 – 09.20 09.20 – 09.40 09.40 – 10.00 10.00 – 10.20 10.20 – 10.45	Plenary Session 2 : Dr. Gajendran Kandasamy (PhD in Physic, Melbourne University ; PhD in Innovation Imperial Collage, London) Prof. Allan O'Connor (University of Adelaide, Australia) Dr. Eng. Wisnu Ananta Kusuma, ST, MT (Bogor Agricultural University, Indonesia) Dr. Frank Neumann (University of Adelaide, Australia) *Discussion*
10.45 – 13.00	Parallel Session A, B and C
13.00 – 14.00	Lunch break
14.00 – 15.30	Parallel Workshop • Strategies for Agroindustry Development • LCA for Agroindustry • Innovation and Technopreneurship for Agroindustry • Agroindustrial Informatics
15.30 – 15.45	Coffee Break
15.45 – 16.15	Closing remark

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ABSTRACTS OF INVITED SPEAKERS

Technology Innovation Adoption to Improve the Performance of Dairy Small-Medium Enterprises (SME): Case study in Pangalengan-Bandung Regency, West Java, Indonesia

Nuni Novitasari[1,2], Titi Candra Sunarti[2], Nastiti Siwi Idrasti [2]
[1]*Centre for Agro-based Industry, Bogor*
[2]*Agro industrial Technology Study Program, Graduate School, Bogor Agricultural University (IPB), Bogor*
Email: nuni.novitasari@gmail.com, titibogor@yahoo.com, nastiti.indrasti@gmail.com,

***Abstract*—** This study explores the conditions and the problems of the production and quality of the product faced by dairy SMEs in Pangalengan-Bandung Regency. This study aims to recommend the technology that might be accepted and adopted to address the problem in the framework of GMP and to identify factors that may influence the adoption of the new technology. Problems related with the quality of the products have been identified and GMP implementation evaluation has been conducted. This research recommends the technology adoption that might be acceptable and adopted to address the problems are: 1. Establishing a process control system. A scheme of standardized production process has been proposed; 2. Mechanization of key processing stage, such as moulding and cutting machines and the use of boiling pans equipped with the thermocouple; 3. Improvement of the product's packaging to enhance protection of the product thus will extend the shelf life. It is suggested to modify the secondary packaging using standing pouch aluminum foil. Factors that may influence the adoption of technology by the SMEs have been identified. The positive factors are: the motivation and efforts to improve the quality and performance of the product; consumers' demand for quality and good manufacturing practices; government or regulatory enforcement; and increasing production volumes. The negative factors are: limited knowledge and educational background of the SMEs' human resources; the reluctance of the SMEs to change their current traditional practices; and financial cost.The SMEs perceived that the relative advantage of GMP implementation is low due to the cost that arise as a results of facilities and equipment improvement. Implementation of GMP and the new technology embodied in it are perceived as complicated by the SMEs. This is caused by their limited knowledge of the concept of GMP and the new technology itself. However, the SMEs perceived that GMP implementation is compatible with their values, needs, consumer's demand, and government regulatory.

Manuscript received July 16, 2015.

Nuni Novitasari is with the Balai Besar Industri Agro, Bogor Indonesia (phone: +62 251 8324068; fax: +62 251 8323339; e-mail: nuni.novitasari@gmail.com).

Titi Candra Sunarti is with the Agro industrial Technology Study Program, Graduate School, Bogor Agricultural University (IPB), *Bogor, Indonesia* (e-mail: titibogor@yahoo.com).

Nastiti Siwi Indrasti is with the Agro Industrial Technology Study Program, Graduate School, Bogor Agricultural University (IPB), *Bogor, Indonesia* (e-mail: nastiti.indrasti@gmail.com).

I. INTRODUCTION

Bacground and Need

SMEs have an important role in the economy of Indonesi, they contribute significantly to the GDP, which amounts approximately to 60 percent and the number of workers absorbed by the sector stood at 97 percent of the total workforce available [3]. However, there are several challenges faced by the SMEs in developing countries, such as sourcing financial capital, human resource competency, technology adoption, etc.[24]. The majority of SMEs in Indonesia still apply traditional practices in terms of production processes and marketing, which indicates the low level of technology adopted [3].

Pangalengan is a sub-district of Bandung Regency that serves as the centre of milk production in West Java. There are many establishments of SMEs of dairy products producing milk caramel, milk nougat, milk dodol, and milk crackers [15]. Initially, the smallholder dairy farmers' motivation was to utilize the fresh milk that could not be absorbed by the big dairy processors due to quality issues. Therefore, they were urged to innovate by processing the excess fresh milk to become more valuable dairy products using simple and limited technology. This process is known as the grass-root innovation. Bhaduri and Kumar [7] define grass-root innovation as the innovation that was done by the grass-root people who have grasped the corresponding techniques and skills and usually due to necessity, hardships and challenges.

Pangalengan has a wide range of traditional dairy products that have been known and appreciated by consumers for years. The main product is milk caramel which amounts to 80 % of total products. These SMEs in Pangalengan produce milk caramel with production capacity ranging between 150 – 1000 l of milk per day involving 10 – 65 workers per each SME. These SMEs contribute to the economy of the region by creating the

added value of the fresh milk (increasing income) and absorbing the workforce (reducing unemployment).a provincial region in Indonesia located on Java Island.

Most of dairy SMEs in Pangalengan lack of technology adoption and GMP implementation, with resulting inconsistency in the quality of the product and limited area of product distribution. This has resulted in the product's low marketability when compared with the milk candy found in the national market which consists of mainly imported products.

Research Purpose

The purposes of this research are: 1. To recommend the adoption of technology in implementing GMP in the SMEs of dairy products (esp. milk caramel) that may improve the quality of the product, and; 2. To identify the positive and negative factors that may influence the adoption of this new technology by the SMEs.

Research Questions

The research questions this research are identified as follow:

1. What are the problems of production and quality of the product? (confirmative and exploratory question)
2. What type of technology innovation might be acceptable and adopted to address the problems?
3. What are the positive and negative factors that may influence the adoption of technology by these SMEs?

Research Limitations

This research is conducted on the dairy SMEs in Pangalengan- Bandung Regency, West Java, Indonesia. The study focuses on the product of grass-root innovation, such as: milk caramel. The research adopts a case study research approach conducted in Pangalengan, thus the result may not be generalisable (typical findings) to another region. The theoretical framework used in this study limits the discussion of the findings based on the GMP theory and innovation adoption theory

II. LITERATURE REVIEW

A. Quality Assurance

Quality is a diverse concept and may be defined in different ways depending on the interest of the manufacturers or the consumer's point of view. The widely known concept of quality introduced by Juran (1988) defines quality as "fitness for use" which means that the product or services should meet the requirement and expectation of the consumers [26]. Industry defines quality as,

"A measure of purity, strength, flavour, color, size, maturity, workmanship and condition, or any other distinctive attribute or characteristic of the product" [26, p. 12]

Quality assurance describes and manages the activities of control, evaluation, audits, and regulatory aspects of food processing system to assure that the product being produced conforms to the standards. Nowadays the quality assurance systems that can be implemented by the food SMEs are those in the ISO Series (ISO 9001:2008, ISO 22000:2005), Hazard Analysis Critical Control Point (HACCP), and Good Manufacturing Practices (GMP) [18],[26].

There have been numerous studies of factors that influence the implementation and adoption of quality assurance systems by the SMEs. Karipidis *et al* [18] reviewed that the influencing factors can be grouped into four categories, which are:

1. Internal benefits or advantages (e.g. improve company's confidence to produce quality product)
2. External benefits or advantages (e.g. improve market share and competitiveness)
3. Internal barriers or disadvantages (e.g. limited trained human resources and limited financial)
4. External barriers or disadvantages (insufficient quality tools and lack of training or education).

There are four basic factors that may encourage SMEs to adopt QAS, which are: their positioning in the marketplace when compared to the competition, the effect of poor quality, the quality culture, and the effectiveness of activities aiming to achieve quality goals [18].

Reference [16] confirmed that the primary motive for adopting a food safety system (GMP, MeSTI) in Malaysian food industry was to improve product quality, while external factors influencing food safety adoption was consumer awareness of food safety and the intention of industry to increase customer confidence.

Another study on the implementation of the quality control system in dairy SME in Bandung suggest that the problems faced by the SME in relation to milk caramels encompass the raw materials quality, processing quality control, human resources management, as well as the product marketing and distribution [15]. However, this study did not clearly evaluate the implementation of Good Manufacturing Practices (GMP) as a quality assurance system that is more practical and suitable for the food SMEs in Indonesia [20]. Thus, it needs further study about the technology that can be accepted and adopted by the milk caramel SMEs to solve the quality problems and improving the implementation of GMP.

B. Good Manufacturing Practices (GMP)

GMP is guidance for food production which is aimed to produce food products with quality, that are safe to be consumed and in accordance with consumers' requirements. Fardiaz (1996) as cited by Herlinawati [17] states that the objectives of GMP application in the food industry are to:

1. Encourage the food processing industry to be responsible for the quality and safety of products produced.
2. Improve the competitiveness of the food processing industry.
3. Improve the productivity and efficiency of the food processing industry.

GMP forms the basis of a foundational platform for a quality assurance program upon which other systems such as food safety system (e.g. ISO 22000, HACCP) could be built to produce consistent quality and safety of the food. GMP provides the basic requirement to assure good practices related to the workers, the facility and environment, the machinery or equipment and also process control [9], [14]. The benefits of GMP

implementation in small dairy factory are related to food safety, longer product shelf life, reduced losses, better working environment, and consumer satisfaction [11].

The GMP standard in this study refers to the Regulation of Head of The National Agency for Food and Drug Control (NADFC) Republic of Indonesia No. HK.03.1.23.04.12.2206 year 2012 about GMP for household and small scale industry [20] and covers the following aspects:

1. Location and production environments
   The location of the food industry should be kept clean, free of litter, odour, smoke, dirt and dust. The environment of the location should be maintained in a clean state.
2. Building and facility
   Building and facility should assure that during the production process, food will not be contaminated by the physical, biological, and chemical hazards, as well as easy to clean and sanitize.
3. Production equipment
   The equipment coming contact with food should be designed and constructed to ensure the quality and the safety of the food produced. Production equipment and containers should be made of materials with no toxic effect, durable, and easy to clean and sanitize in its intended use.
4. Water supply and facility
   An adequate supply of potable water with appropriate facilities for its storage, distribution and temperature control, should be available and meet the requirement of clean water quality or drinking water quality.
5. Hygiene and sanitation facility and activity
   Hygiene and sanitation facility and activity are needed to assure that the building and equipment are in clean condition and to prevent the cross-contamination from the workers. Cleaning facility for washing of food, equipment, supplies and building and employee hygiene facilities (hand washing and toilet) should be available, well maintained, and in a clean state.
6. Personnel health and hygiene
   Food handlers should maintain a high degree of cleanliness, where appropriate, wear suitable protective clothing, head covering, and footwear. Food handlers should avoid the non-hygienic practices that could result in contamination of food, for example: smoking, spitting, chewing or eating, and sneezing or coughing over unprotected food.
7. Maintenance and sanitation hygiene program
   Maintenance and sanitation program for production facilities (buildings, machinery / equipment, pest control, waste handling and other) shall be done periodically to ensure avoiding cross contamination to the processed food.
8. Storage
   Storage of raw materials and finished products should be provided in such a way to avoid the decreasing of quality and safety of the product. The storage of raw materials and finished products must be separated in a clean room.
9. Process control
   The production process shall be controlled properly to produce good quality and safe food product. Process control in food home industry or food SME can be done through the following steps by establishing: a. The raw material specification; b. The raw material composition and formulation; c. The standard operating procedure for the production process; d. The type, size, specification of the packaging; e. The detailed product information, including product's name, production date, expiry date.
10. Food labelling
    The food label should contain the following minimum required information: a. Product's name; b. List of raw materials and ingredients; c. Nett weight; d. Producer's name and address; e. Expiry date; f. Production code; g. Food licence number.
11. Supervision by the person in charge
    A person in charge is required to supervise all stages of the production process and control to assure the food product quality and safety.
12. Product recall
    The owner of the food establishment must recall the product if suspected to cause illness/food poisoning/ and or not meet the requirements of food legislations and regulations.
13. Records and documentation
    Appropriate records and documentation are needed to facilitate traceability of problems related to production and distribution process, to prevent the distribution of products that exceed the expiry date, and to improve the suitability and effectiveness of the food safety and quality management system.
14. Training of employees
    Managers and employees must have basic knowledge and competency regarding the principles and practices of food hygiene, sanitation and food processing in order to produce good quality and safe food.

A study on the implementation of GMP and HACCP plan in a *nata de coco* company shows that it has addressed the issues of physical contamination from equipment, environment, and workers, thus reducing the rejected product from 14.43% to 5.32%. However, there are some issues regarding the implementation of GMP in the developing countries such as: 1. Industry size; 2. Infrastructure; 3. Tradition; 4. Behaviour/attitude; and 5. Financial cost [14].

Applying GMP and HACCP to traditional food processing can effectively manage and control hazards that may be associated with the traditional practices. GMP implementation is an effective system for ensuring the quality and safety in the traditional processing of maize in Ghana [2]. In such traditional operations, GMP can be implemented at minimal cost by relying on simple techniques and instruments such as visual inspections, using pH strips, thermometers, and timing of unit operations.

Yuwono, Zakaria & Panjaitan [28] identified internal and external factors that influence the continuity of GMP application in the fish fillet processing plants. The internal factors are lack of education and lack of experience, whereas the external factors are lack of

government policies in socialisation and training of GMP, lack of potable water and ice supply, lack of law enforcement, and market demand.

C. Technology Innovation Adoption

The introduction of quality assurance concepts to the SMEs that is embodied in the implementation of GMP and the processing technology included can be regarded as a new technology or innovation concept for the SMEs. The implementation of GMP and technology included in it is aimed to improve the product's quality and competitiveness.

The newness of an innovation is measured subjectively by the adopters and more emphasizing in the usefulness and novelty [22]. In the context of a developing country, technological innovation is the process where a company creates and/or applies the new design and/or new production process of goods and services regardless of whether they are new to their competitors, their customers or the world [4].

Accoring to Rogers [22], technology innovation can be classified into hardware technology and software technology. Hardware technology refers to the physical or material objects such as tools, machinery, or equipment, while software technology refers to information base or systems underlying the hardware technology [22]. GMP is the software technology that underlying the usage of hardware technology needed to improve the implementation of the concept.

The rate of technology / innovation adoption is influenced by the perceived attributes of the innovations as explained by Rogers [22] as follow:

1. Relative advantage. This is the degree to which innovation is perceived as better than the existing one. It can be measured by the economic perspective, convenience, and satisfaction.
2. Compatibility. This is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and the needs of the adopters.
3. Complexity. This is the degree to which an innovation is perceived as difficult to be understood and to be applied.
4. Trialability. This is the degree to which an innovation can be trialled prior to full implementation in the real situation.
5. Observability, it is the degree to which the result of an innovation can be observed by others.

This study focuses on the relative advantage, compatibility, and complexity of GMP and relevant technology needed because these three factors have consistently influenced in adoption behaviour of technical innovation than other factors [23].

In addition, Ram and Sheth [21] argue there are five barriers that weaken the adoption of innovation and may lead to the innovation resistance, which are: usage barrier, value barrier, risk barrier, tradition barrier and image barrier. The usage barrier happens when an innovation is not compatible with existing workflows, practices or habits. It is the most probable cause for resistance to innovations. The value barrier arises if the innovation does not offer significant performance-to-price compared to its substitutes. Risk barrier refers to the degree of risks an innovation entails (physical, economic and function). Tradition barrier related to the changes an innovation may cause in daily routines and deviate from established traditions. The image barrier arises due to a stereotyped thinking and perception of an innovation.

There was a study on the technology transfer of some Moroccan traditional dairy products to improve the traditional fermentation process [6]. It proposed the schemes of standardized production stages, in which the processing steps are basically the same as those used in traditional method with the required adjustments for standardization and enhancement of safety and quality of the final products.

Yuwono, Zakaria & Panjaitan [28] used the theory of perceived attribute innovation to study the factors affecting the implementation of GMP in the fish fillet processing unit in Java-Indonesia. The respondents who continue to apply GMP imply that the GMP implementation gave them relative advantages by expanding export market orientation and reducing rejected product. They also perceived that GMP is compatible with their values and customer's values (requirements of the customer and regulation of the export destination countries). They have received education, training, and manual guidance from the government thus they do not perceive GMP as complex. On the other hand, the respondents who decided to stop the GMP implementation perceived that the GMP implementation did not give them relative advantages, not compatible, and difficult to apply.

III. RESEARCH METHOD

The exploratory case study methodology is applied in this study. This research was conducted through four stages, which are: 1. Identification of the dairy SMEs profile in Pangalengan; 2. Identification of current processing technology; 3. Identification of technology adoption that might be acceptable and applied to address the problem; and 4. Identification of factors that may influence the adoption of new technology by the SMEs.

Data was collected by doing the field observation and semi-structured interviews with the respondents [5], [19]. All interviews were recorded and transcribed for analysis [27]. The participants were purposively sampled based on their experience and knowledge:

a. Respondent 1: The owner of AA enterprise, dairy SME in Pangalengan
b. Respondent 2: The owner of BB enterprise, dairy SME in Pangalengan
c. Respondent 3: The owner of CC enterprise, dairy SME in Pangalengan
d. Ir. Agus Sudibyo, MP (Respondent 4): Senior researcher at Center for Agro-based Industry
e. Drh. Asep Rahmat H. (Respondent 5): Processing Unit Manager at The Cooperatives of Bandung Regency Dairy Farmers (CBRDF)

The data were analysed using descriptive and interpretive analyses [27]. The field observation data were analysed by referring to the GMP standard and literature review or practical theory of milk caramel processing technology and quality assurance.

IV. FINDINGS AND DISCUSSION

A. Profile of dairy SMEs in Pangalengan & current technology applied

. BB Enterprise was the pioneer of dairy SMEs in Pangalengan and it is still the leading player in the region with the biggest production capacity, monthly income and number of workers. The government awarded BB Enterprose the Upakarti award as the small-medium scale entrepreneurs who had succeeded in business and surrounding community development.

AA & CC Enterprise were relatively new established (in 2003 and in 2008). The owner of CC was previously an employee of AA and BB. He was an experienced and skilled worker who decided to establish his own enterprise and succeeded. The detailed profile of dairy SMEs in Pangalengan can be seen in Table 1.

Table 1. Profile of dairy SMEs in Pangalengan

General Information	AA	BB	CC
Establishment's Year	2003	1970	2008
Production capacity (l)	200 -300	1000	250-250
Monthly income (Rp)	60,000,000 – 70,000,000	700,000,000 – 800,000,000	50,000,000 – 60,000,000
Human resources			
1. Number of permanent Workers	11	10	0
2. Number of daily workers	20	65	25
3. Education level of workers	Senior High school = 11 workers Elementary school & Junior high school = 20 workers	Senior High school = 10 workers Elementary school and Junior high school = 65 workers	Senior High school = 5 Drop out / Junior high school = 20 workers

Milk caramel is a processed dairy product with a soft chewy texture, brown colour and has a distinctive taste, flavour and aroma. The distinctive properties of milk caramel are the result of the reaction between sugar and milk proteins during the heating process (known as caramelisation and Maillard reaction). Milk fat decomposition during heating in the high-sugar environment also contributes to the distinctive taste of the product [1], [15].

The composition of raw materials and ingredients in the milk caramel consist of fresh milk, sugar, glucose syrup, and margarine. The packaging materials consist of oil paper and HVS paper (as a primary packaging) and printed plastic bag (as a secondary packaging).

The equipment and production technology being used are still simple and manually operated by the workers. The production equipment consists of: plastic milk container, aluminum boiling pan, gas stove, wooden stick stirrer, stainless steel knife, working table, plastic pan, aluminum tray, plastic tray, plastic packaging sealer, and production code stamp.

Heating and cooking is the key processing stage to evaporate the water content of the milk. The cooking process should be done with the stirring along the process to distribute the heat evenly throughout the dough and to avoid the coagulation of the mixture. The First stage of heating is pasteurization that aims to kill the pathogenic bacteria. The original type of heat treatment was a batch process in which milk washeated to 63°C in open vats and held at that temperaturefor 30 minutes [8]. The production process flow of milk caramels is shown in the Figure 1 below.

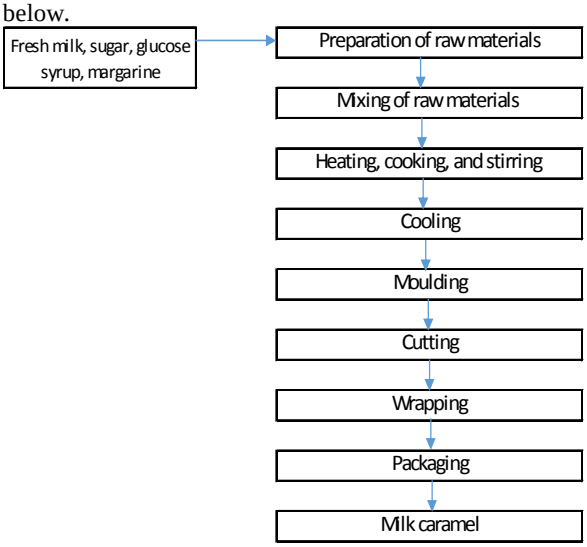

Figure 1. Flow chart of milk caramel production process

B. Problems of production and quality of the product faced by the dairy SMEs in Pangalengan

1. Finished product quality is not consistent in terms of taste, texture, size, and the shelf-life of the product. They often found some defect products in the retailer store before reaching its expiry date. The problems of product's texture & taste related to the production process control, especially in the heating and cooking stage (e.g. overcooking due to lack of time and temperature control).
2. The current secondary packaging, which is a transparent plastic bag, cannot protect the product properly from direct sunlight and high temperature when the product is being displayed in the retailer store. Under this condition, the fat content of milk caramel will seep into the wrapping paper, making it look defective, and the product texture is softened.
3. The causes of the problems are non-standardized production process, low level of GMP implementation and lack adoption of new technology. These SMEs do not have the process and quality control system established, thus the consistent quality of the product is difficult to achieve. In the view of respondent 5,
4. The GMP implementation evaluation shows that there are four main elements that need to be improved by the SMEs and directly affected the product's quality, they are: process control, personnel hygiene, hygiene and sanitation activities, and training of workers.

C. Identification of technology innovation that might be accepted and adopted in implementing GMP to address the problems

Based on the interviews, field observations, and data analysis, it has been identified three types of technology in the framework of GMP that might be accepted and adopted to address the problems,

1. Process control system
   The SOP of production process is established as a guidance of production process. It ensures the production process is carried out through the same stages with standardized condition. The proposed scheme of a standardized production process can be seen in Table 2. The SOP of personal hygiene is established to ensure that food handlers who contact with food do not result in cross-contamination to the food. SOP for sanitation to ensure that all parts of the establishment are appropriately clean.

Table 2. Scheme of standardized production process

No	Process stage	Process quality control
1	Preparation of raw materials	The composition of raw materials is referred to the formulation sheets
2	Fresh milk is heated up the with the addition of sugar, glucose syrup, and margarine.	Milk is pasteurized in a temperature 63-70^{0}C for 30 minutes prior to addition of other ingredients.
3	The mixture is cook in a temperature 115-132^{0}C for 3-4 hours.	- The cooking process should be done by stirring the mixture throughout the process to distribute the heat evenly throughout the mixture and to avoid the coagulation of the mixture. - Temperature is checked by using thermometer. - The end point of cooking stage is determined by checking the mixture stickiness (expert judgement). The dough stickiness can be checked by pouring a sample of mixture into the glass of water. The end point is reached if the mixture hardens and can be broken off by finger.
4	The mixture is cooled until it reaches a temperature 45^{0}C and then it is poured into the molding pan.	The mixture is weighed in the molding pan to make sure the size consistency of each dough sheet .
5	The caramel sheet is sliced and cut into the desired size of milk caramel (1.5 cm x 1.5 cm).	The caramel chunk size is checked visually for its uniformity. SOP personel hygiene is referrred to as a process control of contamination from the foodhandlers.
6	The milk caramel is wraped. The first primary wrapping paper is the oil paper, the secondary wrapping paper is the printed HVS paper.	SOP personel hygiene SOP personel hygiene is referrred to as a process control of contamination from the foodhandlers.
7	Wrapped milk caramel is packed into the plastic bag and weighed as desired (e.g. 100 grams, 200 grams, or 500 grams).	The nett weight of each packed product is measured using the accurate scales.
8	The label sticker of expiry date is stamped on to the front side of the plastic bag.	The expiry date code is checked visually to make sure of the accuracy.

2. Mechanization of key processing stage is desirable, such as manual mixing to be replaced by the mechanically operated machines, the use of moulding and cutting machines, and the use of boiling pans equipped with a temperature monitoring devices (e.g. thermocouple)
3. Improvements in the product's packaging to enhance protection of the product thus extend the shelf life. It is suggested to modify the secondary packaging using standing pouch aluminium foil. Aluminium foil has a good tensile strength and an excellent barrier to light, liquid and foods [10]. Improvement in packaging design and materials will affect the consumer acceptance that might lead to the increase of product marketability.

D. Factors that may influence the adoption of technology by the dairy SMEs

Factors that influence the adoption of technology fall into three categories: 1. positive factors; 2. Negative factors; 3. The perceived attributes of the technology. Positive factors are those that encourage the SMEs to adopt the new technology. Negative factors are those considered to be barriers to technology adoption. While perceived attributes of technology are characteristic of technology innovation as perceived by the individuals.

1. Positive factors

a. Motivation and efforts to improve the quality and performance of the product

The SMEs realize that they have quality issues, and need to improve the production process by implementing GMP and applying relevant technology. Respondent 1 said,

> *"We realize that we still need to improve the quality of the product to be able to survive in this competitive business environment"*

Applying GMP and relevant technology are regarded as efforts of quality improvements and assurance of the products safety to gain consumers' trust. This finding conforms to previous research [16], [18].

b. Consumers' demand for quality and good practices of manufacturing

The increasing awareness of consumers regarding quality and good practices of manufacturing also encourage the respondents to adopt GMP. This is consistent with the previous study by Fernando, Ng and Yusoff [16] that highlighted consumer awareness of

food quality and safety, and the intention of industry to increase customer confidence.

c. Government or regulatory enforcement (e.g. home industry food licence)

To get the food licence, the food SMEs should be audited by the government official regarding the production facilities, production process, hygiene and sanitation requirements that are also included in the GMP. Therefore, the SMEs perceived that regulatory enforcement encourage them to implement GMP. This finding conforms with previous research [18], [28].

d. The Increase of production volumes

The SMEs recognize that they cannot rely on their current technology and working system if there is an increase of production volumes. Implementing quality assurance system such as GMP and adopting mechanized operating machines will become an urgent need to produce products that are safe and good quality.

2. Negative factors

a. Limited knowledge and educational background of the SMEs' human resources

The workers' education level is low because they had only limited secondary education. Consequently, the awareness and knowledge about food processing, hygiene and sanitation practices for the food industry is limited. They do not actively searching for the information for new and up-dated technology. They rely on the local government training event and some academics who visit their site to absorb the information on technology transfer. Respondent 5 said,

> *"Technological changes relate with the educational background of the adopters. In my experience, the high-level education workers are more willing to adapt to the changing of technology"*

b. Reluctance of the SMEs to change their current traditional practices (mindset, experience)

Technology adoption also involves social changes. Changing a mindset, people's attitude and ways of working are considered to be challenging by the SMEs. Respondent 5 said,

> *"These SMEs are still trapped in the stigma or idea that they are producing a traditional product. It is difficult to change their practices to use the GMP concept, as well as introducing the new technology that is relevant"*

GMP implementation requires changes of workers' behaviour and attitude towards hygiene practices. Applying new technology (e.g. moulding and cutting machinery) would require adjustment of knowledge and skill of the workers. Tradition barrier arises in this case and can hamper the adoption of such technology or innovation [11], [14], 21].

c. Financial cost

Improving facilities and equipment to meet the requirements of GMP and adopting new technology additional cost that must be borne by the SMEs. Improving packaging design and material will increase the production cost that eventually affect the product's selling price. Respondent 4 stated,

> "*New technology adoption, whether hardware or software will involve cost to improve the current facilities or technology being used"*

This will be the challenge faced by the SMEs in adopting new technology; otherwise there is government support for them. This finding confirms previous research [11], [14], [18], [28].

3. The technology perceived attributes

a. Relative advantage

The degree of relative advantage is often expressed in terms of economic profitability, meaning that the profit gained needs to be compared with the cost of adopting the technology. The SMEs consideration in adopting the new technology is its usefulness and function. Respondent 5 said,

> "*When we introduce new technology to the SMEs, they will calculate the money they spend against the benefit they will receive*"

In terms of implementing GMP, the benefits are as follows: the improvement of product's quality, assurance of food safety; reduced losses; better working environment; consumer satisfaction; and an extended shelf life for milk caramel. But, there will be costs for improving the hygiene facilities, investing on mechanization of processing stages, and preparing the adequate personal hygiene facility. The SMEs still think that the cost of implementing GMP is too high. Thus, it will need government support, technically and financially, to accelerate the GMP implementation by the SMEs.

Rogers [22] states that adopter incentives increase the relative advantage of the innovation. Adopter incentives can act as a cue-to-action in triggering the adoption of an innovation. To adopt a quality assurance system, SMEs need to believe that performance improvements are guaranteed, because they are not willing to invest in systems that promise only ''potential" returns somewhere along the way.

b. Compatibility

An innovation or technology can be compatible or incompatible with: 1. sociocultural values and beliefs; 2. previously introduced ideas; and 3. the needs for innovations [22]. The GMP implementation is compatible with the needs of the SMEs to address the problems of production and quality of the product. This fact is supported by the identified positive factor which is motivation and efforts to improve the quality and performance of the product.

The GMP implementation is perceived to be compatible with the needs of the customers. This has been identified in the positive factor which is consumer's demand for quality and good practices of manufacturing.

The GMP implementation is also perceived compatible with the government and regulation enforcement. In order to get the food licence, the SMEs should be audited by the local government officer to

examine the properness of the establishment, and that include aspects required by GMP.

c. Complexity

Implementation of GMP and the new technology embodied in it are perceived as complicated by the SMEs. This is caused by their limited knowledge regarding the concept of GMP and the new technology itself. Respondent 3 said

> *"I'm not familiar with GMP, I don't think I have received the information or training about that. But as a food producer, of course, I implement some of the concepts, such as the cleanliness, and the hygiene practices"*

Complexity can be associated with tradition barrier of innovation adoption. Ram and Seth [21] suggest strategy to overcome the tradition barrier by educating the consumers of an innovation and the use of change agents.

Suitable training programs about GMP and the relevant technology ought to be provided to improve the competency of human resources in dairy SMEs. The change agent might refer to the officials of Local Government Bureau of Health (local food inspector) who assist and monitor the GMP implementation by the SMEs. This indicates that government's role is needed in distributing the information about GMP and transferring technology to the SMEs. This conforms with previous research [17], [18], [25], [28].

V. CONCLUSION

Problems related with the quality of the products have been identified and GMP implementation evaluation has been conducted. This research recommends the technology adoption that might be acceptable and adopted by the dairy SMEs to address the problem as follow:

1. Establishing a process control system. A scheme of standardized production process has been proposed.
2. Mechanization of key processing stage, such as moulding and cutting machines and the use of boiling pans equipped with the thermocouple.
3. Improvement of the product's packaging to enhance protection of the product thus will extend the shelf life. It is suggested to modify the secondary packaging using standing pouch aluminium foil.

The SMEs perceived that the relative advantage of GMP implementation is low due to the cost that arise as a results of facilities and equipment improvement. Implementation of GMP and the new technology embodied in it are perceived as complicated by the SMEs. This is caused by their limited knowledge of the concept of GMP and the new technology itself. However, the SMEs perceived that GMP implementation is compatible with their values, needs, consumer's demand, and government regulatory.

Implications of the Research

1. Implications of a practical kind at the workplace level in the SMEs

The proposed standardized production stages, raw material and finished product specification, SOP for personal hygiene, and SOP for sanitation might be implemented by the SMEs in daily operation.

2. Implications of a policy making kind by the government
   a. Local government needs to create a long-term and continuous program in assisting the SMEs to implement GMP and adopting the technology needed. Officials of Local Government Bureau of Health (local food inspector) can be the change agent who assist and monitor the GMP implementation by the SMEs.
   b. The government needs to play significant role, by supporting and providing the infrastructure for the SMEs, providing trainings related with the sanitary production process and good manufacturing process for SMEs, and conducting regular monitoring of GMP implementation.
   c. The government may participate in creating external business environment that would encourage the adoption of GMP with emphasis on information distribution and acknowledgement of GMP adoption by the SMEs to gain customers' trust.

Further Research Direction

To enlarge the scale of research in this field, the researcher suggests to involve more SMEs respondents in other regions (representatives of the population). The respondents' selection criteria can be based on those who already adopt the GMP and those who do not as a comparison. Quantitative analysis of GMP implementation evaluation, by using a numbering scale, would add more valuable information to this research.

Another interesting research topic would be to address the issue of GMP implementation relative advantages. Thus it will need a calculation of cost and benefit in implementing the GMP.

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