https://doi.org/10.1051/bioconf/20249902014

Study of HACCP (Hazard Analysis And Critical Control Point) identification in anchovy sago noodles processing

Diki Nanang Surahman[1*], *Wisnu* Cahyadi[2], *Maisa Hamdu Nurani* Alifia[2], *Christina* Litaay[1], *Hendarwin M*. Astro[1] and *Taufik* Rahman[1]

[1]Research Center for Appropriate Technology, National Research and Innovation Agency, 41213 Subang, Indonesia
[2]Program Study of Food Technology, Pasundan University, 40153 Bandung, Indonesia

Abstract. Noodles are a practical food product that the people of Indonesia love. Many efforts to diversify noodle products by substituting non-gluten ingredients such as sago. The pilot plant of the Research Center for Appropriate Technology, Subang is one of the models for processing sago flour into dry noodle products fortified with anchovy flour. In its operation, it is necessary to apply the HACCP system. The HACCP identification study was conducted using the HACCP Plan Preparation Guide, with its preparation following the principles of the HACCP system recommended by the Codex Alimentarius Commission and Indonesian National Standards. The results of the study showed that the process stages set as CCP in the manufacture of anchovy flour is drying. In addition, the process stages set as CCP in making anchovy sago noodles is tempering. All of these CCPs must receive optimal supervision including adequate temperature and drying time of fish and environmental humidity.

1 Introduction

Ensuring food safety is critical in the 21st century, particularly with the growing consumer demand for complex food products [1]. Food safety is essential to a food product because its application can prevent the product from danger. These hazard risks can occur in every raw material and stage of the production process related to the danger of contamination, biological, chemical, and physical [2], so proper handling and processing are needed to prevent contamination. To ensure the safety of the products produced, it is necessary to carry out a hazard control system; one often used to be HACCP.

The quality and safety of a product depend on the quality of the raw materials used, as well as their handling and processing [3]. Noodles are one of the suitable food products that the people of Indonesia love. Many diversification efforts are carried out by substituting wheat flour with non-gluten ingredients such as sago. Sago, which contains high carbohydrates and calcium, phosphorus, and iron, can be used as a substitute for wheat flour.

* Corresponding author: diki.lucky@gmail.com

Based on their nutritional content, anchovies contain 65-77.9% water, 12.8-19.8% protein, 1.81-15.3% fat, and 1.5-2.3% ash [4]. Due to the low protein content in sago flour, adding anchovy flour can increase the nutritional content, such as protein in sago noodle products [5].

The HACCP system and its implementation are very effective. They can help the food industry to comply with laws, meet food safety requirements for customers, and produce products that are safe for consumers because they have an impact on reducing foodborne diseases. In addition, the implementation of HACCP in the food industry has a good impact on company finances which leads to an increase in company profits, increased sales, and reduced production costs [6-9].

Previous research related to the HACCP study was carried out by Jumiono et al. [10] on Glossy noodle SMEs in Bogor. Other HACCP studies were also carried out by Arevalo et al. [11] and Farag et al. [12]. From the results of previous studies, there have been no studies that have conducted HACCP studies on the manufacture of anchovy sago noodles. This study aims to identify danger points in making anchovy sago noodle products using the HACCP concept so that control can be carried out and reduce the risk of harm to the products produced.

2 Method

The research was conducted on the pilot plant of the Research Center for Appropriate Technology Subang, West Java. The data collection method was implemented using a survey approach. The research involved direct observation of activities and process flows related to handling frozen tuna loin, spanning from the initial stages of production to the final product. The data analyzed comprises both primary and secondary data. Primary data was acquired through interviews, direct field observation, hazard analysis, identification of critical control points, supervision of critical control points, and physical testing.

The data is then analyzed descriptively and compared with existing standards. This study refers to the HACCP concept according to the Codex Alimentarius Commission [13], which was also adopted by the National Standardization Agency, namely SNI 01-4852-1998 [14], concerning hazard analysis systems and control of critical points.

The study of HACCP identification in the process of making anchovy sago noodles carried out includes: Step 1: Assemble the HACCP team; Step 2: Product Description ; Step 3: Identify Product Usage; Step 4: Construct the Flow Chart; Step 5: Verify the Flow Chart ; Step 6 : Principle 1: Analysis of Potential Hazards and Determination of Control Measures; Step7 : Principle 2: Critical Control Point (CCP) Determination; Step 8 : Principle 3: Establish Critical Limits for Each CCP.

3 Result and discussion

3.1 Assemble the HACCP team

Forming a HACCP team is essential in the early stages of preparing a HACCP plan where each member of the HACCP team comes from different areas of expertise. The HACCP team formed will later collect all the information needed to prepare the HACCP plan. The HACCP team consists of a head and members, each of whom has their expertise and duties. Some areas of expertise the HACCP team requires are food technology, food microbiology, food chemistry, and mechanical engineering. The HACCP team can be seen in Table 1.

Table 1. HACCP team preparation.

No.	Field of Expertise/ Department	Position
1	Food Technology/Management	Head
2	Food/Production Technology	Member
3	Microbiology Food / QA	Member
4	Food Chemistry / QC	Member
5	Mechanical Engineering/Technician	Member

3.2 Product description

Anchovy sago noodles are a diversified product of dried noodles using raw materials for sago flour (*Metroxylon* sp) and fortified using anchovy flour (S*tolephorus* sp). The anchovy sago noodle product consists of sago flour, anchovy flour, water, and salt. The shelf life of sago anchovy noodles is four months, and they are packaged in polypropylene plastic packaging. The target consumer for anchovy sago noodles is the general public. A complete product description can be seen in Table 2.

Table 2. Product description

Product name	Anchovy sago noodles
Composition	Sago flour Anchovy flour Water Salt
Types of packers	PP plastic (15 cm x 30 cm x 0.08 cm)
Shelf life	Four months
Storage conditions	Stored at room temperature (27°C)
Target consumer	For common
Test results	Water content = 12.76% Ash content= 3.11% Protein content= 4.08% Fat content= 0.38% Escherichia coli = 0 MPN/g Mold & yeast <10 colonies/g

3.3 Identify product use

This anchovy sago noodle product is intended for general consumers serving it boiled in boiling water for 6-7 minutes, then drained and served.

3.4 Construct flowchart

There are two process flow diagrams: making anchovy flour and anchovy sago noodles. The process flow diagram includes all stages of the process, from when the raw materials are received until the product is ready for distribution for verification in the next step. The flow chart can be seen in Fig. 1 and Fig. 2.

3.5 Flowchart verification

All stages of the process in the flow chart must be by the stages of the process that occur. This flow chart verification stage needs to be done because this verified flow chart will later become a reference.

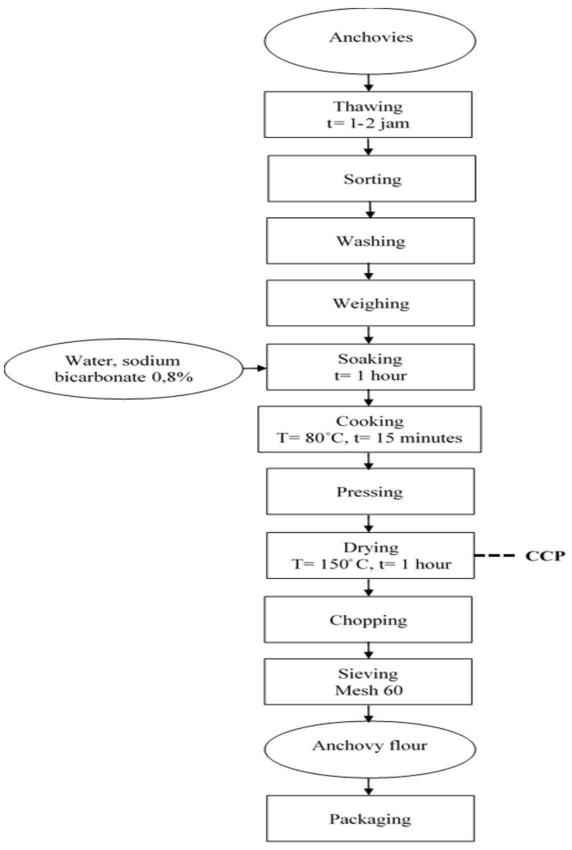

Fig. 1. Flow chart process of anchovy flour.

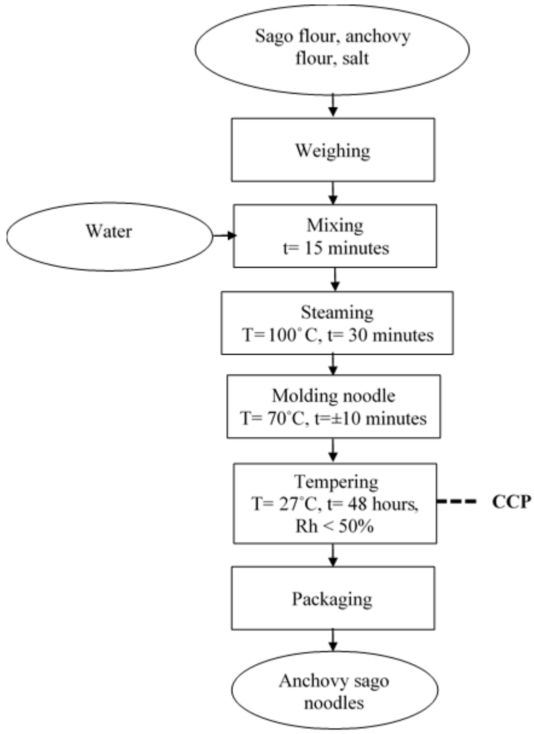

Fig. 2. Flow chart process of anchovy sago noodles.

3.6 Identification hazard of raw material

A comprehensive analysis of potential hazards encompasses biological, chemical, and physical risks associated with all raw materials and process stages. Analysis of the potential hazard of raw materials can be seen in Table 3. The first raw material is anchovies (*Stolephorus sp*) obtained from the Blanakan Fish Market in Subang. If ice on fresh anchovies is not appropriate, it can cause problems during the distribution process and result in the anchovies not being fresh when they arrive at the location of the fish auction. Control measures that can be taken to minimize the risk of danger are the use of 1:1 ice. In addition, can be taken care of by checking the freshness of fish with physical characteristics of fish including convex and brilliant eyeballs and clear corneas, fresh red gill color, natural mucus covering the surface of the fish, skin color is not pale; scales are firmly attached and shiny, and chewy fish meat which is marked if pressed with fingers without marks [15].

The second raw material is sago flour (Metroxylon sp) obtained from Ambon, Maluku. The hazard that can be identified from sago flour is potential for enzymatic browning caused if the handling process and the length of wet sago storage in the production site are too long, affecting physical properties, especially color. This can occur due to phenolase enzymes, which, if reacted with oxygen, will cause browning in sago flour and reduce the quality of sago flour produced [16]. Control measures to check the certificate of analysis (CoA) from the supplier to ensure that sago flour is safe for use.

The next raw materials are sodium bicarbonate and salt. Sodium bicarbonate is used as an auxiliary material in the soaking process which to reduce the fat content of the anchovies. Meanwhile, salt is added to the noodle dough. In the raw materials sodium bicarbonate and salt there are no identified hazard risks because the materials have been certified by BPOM so that it can be stated that sodium bicarbonate and salt are safe to use in the process of making anchovy flour and sago anchovy noodles.

Water is the last raw material for making fish flour and anchovy sago noodles. The water used is sourced from PAM. The risk of danger in PAM water is potentially turbid, which may be caused by less-than-optimal water treatment so that deposits such as sludge can be carried away. Turbid water can be removed by adding alum or chlorine. However, using chlorine in excess amounts can leave residual chlorine that can be harmful to health. Control measures can be taken if there is a danger of chlorine residue in the water by carrying out further water treatment, such as using anti-chlorine or precipitation for at least 12 hours [17].

3.7 Critical Control Point (CCP) determination

The hazard risk analysis in the anchovy flour process can be seen in Table 4. In contrast, the hazard risk analysis in the anchovy sago noodle process can be seen in Table 5.

The application of a decision tree facilitates this determination. In making an anchovy flour, the process that become CCP is drying. While the stages of the process that become CCP in anchovy sago noodles process is tempering.

The process of anchovy flour that indicated as CCP is drying. The tool used in the drying process is an electric oven with a temperature of 150° C for 60 minutes. The risk of danger that can be identified is uneven drying caused by fish layers placed on a tray that is too thick and not uniform and the presence of clumped fish so that the fish is not completely dry. If the fish is not dried evenly, it can affect the quality of the fish flour. Control measures can be taken by placing fish in trays with uniform thickness, ensuring no fish clumping, setting the appropriate temperature and time.

In addition, the process of anchovy sago noodles that indicated as CCP is tempering. The tempering process is carried out in a particular room where the printed noodles are placed on a tray and stored on the special shelf tempering. The risks that can be identified are physical hazards in the form of dust coming from the tempering environment and microbiology in the form of the growth of microorganisms such as molds on noodles. Control measures to minimize hazards are by controlling humidity in the tempering room by equipping the tempering room with a humidity measuring device, the use of an air conditioner is essential for this process because the air conditioner can reduce the air humidity of the tempering environment and speed up the noodles to dry. Relatively safe humidity for dry food products is below 50% to inhibit the growth of microorganisms [18].

3.8 Establish critical limits for each CCP

A critical limit is a maximum or minimum value at which a physical, biological, or chemical hazard must be controlled to prevent, eliminate, or reduce an acceptable hazard level. This critical limit must be factual, measurable, and specific. The data in the CCP matrix is seen in Table.

Table 3. Identification hazards of raw material.

Raw Materials	Risk of hazard (Biological/Chemical/Physical)	Hazard		Significance (RxK)	Causes of hazard	Control measures
		Risk	Severity			
Anchovies	P: Less fresh	10	10	100 (Not Significant)	When the use of ice is less than the fishing location causes a decrease in the freshness of the fish.	Ice use 1:1
Sago Flour	K: Enzymatic browning				If the handling process at the sago production site is incorrectly	CoA from the supplier required Checking the quality of raw materials organoleptic
Sodium Bicarbonate	Raw material hazard is not identified					
Salt	Raw material hazard is not identified					
Water	P: Turbid	100	100	10.000 (Not Significant)	Water treatment is less than optimal Excess chlorine dose used	Do advanced water treatment (precipitation or addition of anti-chlorine)

Table 4. Risk hazard analysis of anchovy flour process.

No	Process	Risk of hazard (Biological/ Chemical/ Physical)	Hazard		Significance (RxK)	Causes of hazard	Control measures
			Risk	Severity			
1	Thawing	Stage process hazard is not identified					
2	Sorting	Stage process hazard is not identified					
3	Washing	Stage process hazard is not identified					
4	Weighing	Stage process hazard is not identified					
5	Soaking	Stage process hazard is not identified					
6	Cooking	Stage process hazard is not identified					
7	Pressing	Stage process hazard is not identified					
8	Drying	B: Microbial growth if drying is uneven	10	10	100 (Not Significant)	If laying of fish on trays too thick and uneven If the temperature and time settings on the oven do not match	Make sure that the thickness of the fish is even and that there are no clumped fish. Temperature regulation and drying time accordingly
9	Chopping	Stage process hazard is not identified					
10	Sieving	Stage process hazard is not identified					
11	Packaging	Stage process hazard is not identified					

Table 5. Risk hazard analysis of anchovy sago noodles process.

No	Process	Risk of hazard (Biological/ Chemical/Physical)	Hazard		Significance (RxK)	Causes of hazard	Control measures
			Risk	Severity			
1	Weighing	Stage process hazard is not identified					
2	Mixing	Stage process hazard is not identified					
3	Steaming	Stage process hazard is not identified					
4	Molding Noodles	Stage process hazard is not identified					
5	Tempering	B: Mold growth	10	10	100 (Not Significant)	If high humidity of tempering environment	The use of humidity measuring devices in tempering rooms The use of fans during the tempering process
6	Packaging	Stage process hazard is not identified					

Table 6. Critical control point (CCP) matrix

CCP	Process	Risk of hazard	Causes of hazard	Critical limits	Control measures
1	Drying	B: Microbial growth if drying is uneven	Laying of fish on trays too thick and uneven The temperature and time settings on the oven do not match	Temperature = 150°C Time = 60 minutes The moisture content of fish flour <12% [19]	Make sure that the thickness of the fish is even and that there are no clumped fish. Temperature regulation and drying time accordingly
2	Tempering	B: Mold growth	If high humidity of tempering environment	Humidity <50% Mold & yeast = max 10^4colony/g [20]	The use of humidity measuring devices in tempering rooms The use of fans during the tempering process

4 Conclusion

It can be concluded that there are no raw materials that are indicated as critical control points (CCP) in the process of making anchovy flour and sago anchovy noodles. Process stages indicated as critical control points (CCP) in process of anchovy flour is drying, so needs to control by ensuring sufficient heat in drying fish. Process stages that are indicated as critical control points (CCP) in process of anchovy sago noodles is tempering so that environmental humidity must controlled. Identifying HACCP and applying the HACCP system in making anchovy sago noodles can reduce the risk of safety hazards from the anchovy sago noodle products. To determine the effectiveness of the application of the HACCP system in the process of making anchovy sago noodles, it is necessary to monitor with a particular frequency, determine corrective actions and documentation so it can see how far the control of the HACCP system is running and can be evaluated on the application of the HACCP.

References

1. F. Fung, H.S. Wang, S. Menon, Biomedical Journal **41,** 2, 88–95 (2018)
2. A. Fakhmi, A. Rahman, L. Riawati, Jurnal Rekayasa dan Manajemen Sistem Industri **2**, 6, 1168-1179 (2013)
3. S. Kamolchote, T. T. Seng, J. González, G. G. Hou, Asian Noodles, **1**, 363–392 (2010)
4. C. Litaay, A. Indrianti, Sriharti, N. K. I. Mayasti, R. I. Tribowo, Y. Andriana, R. C. E. Andriansyah, Food Science and Technology **42**, e75421 (2022)
5. G. Boran, M. Boran, H. Karacam, J. Food Qual. **31**, 503–513 (2008)
6. K. Fai Pun, P. Bhairo-Beekhoo, Asian Journal on Quality **9**(1), 134–152 (2008)
7. M. Z. El Rouby, H. E. Bahlol, A. I. El Desouky, A. M. Sharoba, A. H. Darwesh, Journal of Food and Dairy Sciences **11**, 12, 321-329 (2020)
8. T. Minor, M. Parrett, Food Policy **68**, 206213 (2017)
9. F. Liu, H. Rhim, K. Park, J Xu, C. K. Y. Lo, International Journal of Production Economics, 107838 (2020)
10. A. Jumiono, E. Dihansih, I. Rochmana, Jurnal Pertanian **11,** 1, 29-38 (2020)
11. H. A. A. Arevalo, E. M. M. Rojas, K. B. B. Fonseca, S. M. V. Mejia, Food Control **138**, 1-12 (2022)
12. M. A. Farag, T. J. Ashaolu, H. Guirguis, I. Khalifa, eFood, **4**, 2, e69, 1-13 (2023)
13. Codex Alimentarius Commision, Hazard Analysis Critical Control Point (HACCP) System and Guidelines for its Application Annex to CAC/RCP 1-1969 (2020)
14. BSN, SNI 01-4852-1998, Analisa Bahaya dan Pengendalian Titik Kritis Badan Standarisasi Nasional Jakarta (1998)
15. BPOM, Pedoman Cara Pengolahan dan Penanganan Pangan Olahan Beku Yang Baik, Badan Pengawas Obat dan Makanan Jakarta (2021)
16. D. Yumeina, S. Adil, Samsuar, *The effect of soaking sago starch in acetate acids on the whitness degree of sago flour*, in IOP Conference Series: Earth and Environmental Science, 807032006 (2021)
17. H. Anam, Jurnal Medika Bio Sains (2018)
18. J. E. Hyun, J. H. Kim, Y. S. Choi, E. M. Kim, J. C. Kim, S. Y. Lee, Journal of Food Safety **38,** 2, 12433 (2018)

19. BSN, SNI 01-2715-1996 Syarat Mutu Tepung Ikan, Badan Standarisasi Nasional Jakarta (1996)
20. BSN, SNI 8217-2015, Syarat Mutu Mi Kering, Badan Standardisasi Nasional Jakarta (2015)