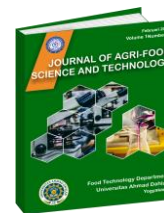


## Journal of Agri-Food Science and Technology (JAFoST)

Journal homepage <http://journal2.uad.ac.id/index.php/jafost>  
Journal email [jafost@tp.uad.ac.id](mailto:jafost@tp.uad.ac.id)



# Receiving and Storage Process Analysis Raw Materials using Check Sheet Method and Fishbone Diagram

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### ARTICLE INFO

#### Article history

Received 25/01/24

Revised 09/04/24

Accepted 19/04/24

#### Keywords

Arrowroot starch;  
Cereals;  
Fishbone;  
Raw materials;  
Storage

### ABSTRACT

Raw materials are very important to make sure finished product have a good quality or as the standard Company. Storage of raw materials can cause physical and chemical damage as well as the development of microorganisms and shorten the shelf life of materials. The method of data collection is done by collecting primary data in the form of observations, interviews and documentation. Secondary retrieval in the form of literature study which is then carried out the problem-solving analysis in the form of check sheets and fishbone diagram. Raw material was compared the company's standards with SNI regarding the quality requirements of arrowroot starch. The results show that the main cause of non-compliance with the company's SOP comes from humans. It can be concluded that the incoming raw materials are weighed and quality checked by QC by storage of raw materials by the storage criteria of each raw material including temperature, storage time, room and storage position. At the same time, we have measures accident which have greater occurrence probability to eliminate the risk of rejected product.

 10.12928/jafost.v5i2.7313

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## 1. INTRODUCTION

Raw materials are very important for the quality of finished products, especially for food product (Surareungchai et al., 2021). Critical raw materials are raw materials that are of economic and strategic importance to the economy but supply risk is high. It forms a strong industrial base producing a variety of goods and applications used in daily life and modern technology (Ferro & Bonollo, 2019). Many food safety and the quality risks come from raw materials and impact for further processing (Surareungchai et al., 2021). Nutrient sources known as raw materials serve as based for the creation of functional foods and nutraceuticals. This specification provides details on a wide range of indications, such as the chemical composition and physical qualities of the substance, structure, sensory aspects, and in certain situations, sources. The raw materials acquired through widely recognized analytical techniques enable food manufacturers to choose the safest raw material that satisfy their technological requirements. The definition of "raw material" is fairly broad and is constantly changing as new

and more sources of nutrients are discovered. Here is a simplified description of raw materials arranged in a systematic manner (Sarkisyan et al., 2017).

Raw materials are classified according to their source of origin into four primary categories, which are, plant-based, animal-based, water-based, and mineral-based. Plant-based raw materials predominantly originate from cereals, leguminous plants, fruits, vegetables, oil seeds, and algae, serving as crucial components in various industries such as food, pharmaceuticals, and biofuels. Animal-based raw materials typically include dairy, meat, fish, and other derivatives such as gelatin and collagen, which have applications in both food production and other industries like cosmetics and medical devices (Sandoval et al., 2024). Water-based raw materials involve components like aquatic plants, seaweed, and marine organisms, which are widely used in industries ranging from food to biotechnology. Mineral-based raw materials are extracted from the earth and include materials like salt, limestone, clay, and other essential minerals used across a diverse array of industrial applications. Care in handling raw materials is critical to ensure the integrity and accuracy of subsequent analysis. Sampling must be conducted with clean, dry, and contaminant-free apparatus to avoid introducing impurities that could affect results. Protecting samples, containers, and sampling instruments from environmental factors such as rain, dust, and airborne pollutants is essential. Effective sampling techniques are designed to yield a homogeneous sample, mitigating issues like fractionation of oil or water content, which can compromise the representativeness of the sample. Before analysis, several prerequisites must be fulfilled. Laboratory conditions should be appropriate, ensuring controlled environments that minimize external interferences. The rules for proper sample selection must be strictly adhered to, as the choice of sampling method and procedure directly affects the reliability of analytical outcomes (Melcher et al., 2021). The matrices of raw materials, particularly for food, represent highly complex systems. These systems often pose challenges in isolating the target components due to interactions among their various elements. The primary focus of raw material analysis in plant- and animal-based products generally involves determining the major macro-components: proteins, fats, carbohydrates, water, and ash. These measurements are essential for quality control, nutritional assessment, and compliance with industry standards. Additionally, understanding the composition of these raw materials allows for optimization of processing techniques, better product formulation, and enhanced functionality in the final products (Barbinta-Patrascu et al., 2024; Sarkisyan et al., 2017).

It is important that these materials are not classified as ‘critical’ because these materials are considered scarce, rather they are classified as ‘critical’ because they have a significant economic importance for key sectors in economy, such as consumer electronics, environmental technologies, automotive, aerospace, defense, health and steel, they have a high-supply risk due to the very-high import dependence and high level of concentration of set critical raw materials in particular countries, there is a lack of (viable) substitutes, due to the very unique and reliable properties of these materials. Raw materials criticality assessment is a very difficult task (Ferro & Bonollo, 2019). Supervision has the meaning as an activity carried out to find out, assess and evaluate the implementation of activities, whether they are in accordance with what was planned or not yet. Furthermore, it is necessary to evaluate and correct the results achieved prioritized (Pramukti, 2016). The standar of food product have focused on product safety, quality, and authenticity risks. Integrity of food product can be impact by raw materials (Surareungchai et al., 2021).

Arrowroot tubers are a fairly high source of carbohydrates and fiber with a low GI value (Fidianingsih et al., 2022; Lestari et al., 2017). The high levels of carbohydrates and energy make arrowroot tubers can be used as a substitute for the common source of carbohydrates consumed by the public, namely rice. Starch in *flakes* can affect the final characteristics of a food product because starch can change during the processing. In the steaming process, the

presence of hot steam produced from boiling water and the presence of water molecules in the flake dough causes the pre-gelatinization of starch to occur. At this stage, water will enter the starch granules causing swelling of the granules. In the roasting process, evaporation of water occurs which causes cavities to form in the starch granules. This will produce a crunchy texture on the flakes (Hu et al., 2014; Rahmadhia et al., 2024). Apart from arrowroot starch, another raw material for making cereals is margarine, which functions as a lubricant for the dough, improves texture and adds to the taste of food. Margarine can also coat proteins and starches which affect the shrinkage and crispiness of baked products (Rukmini & Naufalin, 2015; Salma et al., 2024). Fishbone diagram model to established and analyze the causes of all risk qualitaively. It can used to established risk grade of low middle and high risk factors rejected product (Alfarisy & Rahmadhia, 2022; Luo et al., 2018).

## **2. MATERIALS AND METHODS**

### **2.1. Materials**

#### **2.1.1. Arrowroot Starch**

Arrowroot or arunta (*Maranta arundinacea*) is tropical herb present great potential highly digestible and gluten-free can be used for people with dietary gluten (Barroso & del Mastro, 2019; Malki et al., 2023). Arrowroot characterization of starch was done to identify the nutritional, physicochemical, and functional properties to evaluate the potential in food industry. Arrowroot starch colour was closely similiar to colour of wheat flour indicating that the effect of colour is minimum when replacing wheat flour. Length of starch granules was 44.99 while the width of granules was 31.44, consisted of low crude protein was 0.72%, crude fat 0.26% and crude fiber 1%. Arrowroot stach had high viscosity defining its potential as a thickener (Malki et al., 2023).

#### **2.1.2. Margarine**

Margarine is a low-cost alternative, compared to butter and other fat-soluble products, regarding its nutritional value there are controversies, some authors indicate that it has a low nutritional value and its lipid composition is difficult to digest. However, these characteristics depend on the initial oxygen concentration in the aqueous phase and in the fat mixture, the presence of pro-oxidants and antioxidants, the interface structure (Ariza-Ortega et al., 2023).

#### **2.1.3. Water**

Drinking water has a special function when used for technological purposes as a raw material for the creation of functional meals and nutraceuticals. Even if it's not often considered so, water is one of the most commonly used raw materials. Water Analysis is one of the main methods Gravimetry for studying the composition of raw materials and deals with the quantitative determination of analytes based on the mass of the solid components of the sample. The non-specific nature of these methods has significantly limited their application. However they are considered decisive in some quality indicators of raw materials such as moisture content and some solid content (depending on sample preparation) (Sarkisyan et al., 2017).

### **2.2. Research Methods**

The data collection method was carried out in three ways, namely the observation method with direct observation in the field, interviews and documentation. Direct observation was carried out as long as the researcher followed the entire production process, in this case some data was obtained by the researcher according to the company's condition. Interviews were conducted by asking directly those who have the capacity to answer questions regarding the entire production process of arrowroot tuber cereal products. Data acquisition is done by recording, collecting data from documents, reports, or taking pictures related to the object of

discussion. The analysis is carried out by evaluating the control of raw materials using check lists, check sheets and cause-and-effect diagrams (fishbone). Then do a problem-solving analysis in the form of a check sheet and fishbone. The check sheet developed in this helped improve the similarity of service movements between different kinds of services, and was proven to be effective and used self-checks to evaluate their action using a check sheet (Oeda & Kosaku, 2018). Fishbone diagram needs to be analyzed step by step and drawn according to the logic. First we have to make sure the accident or problem to be analyzed and be describe them. Then determine the leading causes rejected product by raw materials (Luo et al., 2018). As well as by comparing company standards with SNI 01-6057-1999 regarding the quality requirements of arrowroot starch.

The methods of measurements can be classified into the following main groups based on the physical principle underlying the research: gravimetry, refractometry, spectroscopy, mass spectrometry, chromatography, stable isotope analysis, enzymatic, immunological, and DNA methods (Liu et al., 2023). Gravimetry is one of the main methods for studying the composition of raw materials and deals with the quantitative determination of analytes based on the mass of the solid components of the sample. The non-specific nature of these methods has significantly limited their application. However they are considered decisive in some quality indicators of raw materials such as moisture content and some solid content (depending on sample preparation) (Sarkisyan et al., 2017).

### 3. RESULT AND DISCUSSION

Raw material, the process of receiving raw materials and storing raw materials. Arrival of raw materials must be checking of quality raw materials are to ensure the quality of the raw materials is good (Wakabayashi, 2011), it is necessary to supervise and check the process of receiving and storing raw materials at PT Need to be supervised at the time arrival ingredients raw materials to ensure the amount of raw materials is in accordance with the quantity ordered by the company and according to the company's quantity standards. Regarding with supervision and quality checking of raw, both still done very manually by doing physical checking only without chemical and microbiological checking . Furthermore, improper storage of raw materials can cause physical and chemical damage and the development of microorganisms and shorten the shelf life of materials. Therefore, proper handling and supervision is needed in the raw material storage system to maintain the quality of raw materials.

The raw materials used in the manufacture of plain cereal products at PT Serelia Prima Nutrisia are arrowroot starch and margarine. The basic ingredient and source of starch commonly used in plain cereal products is wheat flour. However, the presence of gluten in wheat flour makes food products made from wheat flour unable to be consumed by people with celiac disease , and avoided for people with diabetes mellitus (Hosseini et al., 2019). The raw material standard used by PT Serelia Prima Nutrisia is in the form of physical checking standards. Special For arrowroot starch, the standards used are quantity and quality standards (packaging condition, color, shape, aroma, size, foreign matter, gel properties, and gel color). In the process of supervising the receipt of raw materials and storage of raw materials, cases of arrowroot starch raw materials that arrive do not comply with company standards are often encountered, so they are returned to the supplier. While the monitoring of material storage has not been carried out by the checking process so that it cannot be ascertained that the raw materials used are still in good condition. Therefore, supervision and evaluation at the stage of receiving and storing materials raw urgent to do so that the raw materials used are of good quality. This is done to support the smooth running of production activities and reduce product damage due to raw materials.

Supervision of raw materials at PT Serelia Prima Nutrisia helps in maintaining and

guaranteeing the quality of raw materials. Raw material control at PT Serelia Prima Nutrisia is carried out by quality control (QC). The supervision carried out includes procedures for receiving raw materials and storing raw materials. Raw materials received by PT Serelia Prima Nutrisia first come to the office and are received by the Finance Department with proof of payment which are then sent to production and received by QC. However, there is no proof of receipt of raw materials that have been received by QC. Therefore, it is necessary to make a Raw Material Receipt to prove that the raw materials have been received. As well as PT Serelia Prima Nutrisia must have a stock card, so that if there is a shortage of goods it can be immediately known (Rahmawati et al., 2022). Slip for raw materials received by QC can be seen in Figure 1.

Logo Perusahaan		SLIP PENERIMAAN BAHAN BAKU (SPBB)		Nomor : Tanggal :	
Diterima dari Supplier :					
Nomor Surat Jalan :					
Nomor QC :					
No.	Kode Barang	Nama Bahan Baku	Jumlah	Satuan	Keterangan
Disetujui oleh Supplier :		Diketahui oleh :		Diterima dan dihitung oleh :	
		<b>PASS QC</b>			

Figure 1. Acceptance slips of raw materials.

The raw materials used in the manufacture of plain cereals at PT Serelia Prima Nutrisia are arrowroot starch and margarine. Arrowroot starch and margarine have different handling upon arrival of raw materials. Arrowroot starch that comes in bulk or sacks with the weight per bag set by the company is 25.10 kg with the company's standard maximum moisture content of 16% (Witasari et al., 2024). The water content test is carried out annually by the supplier. Arrowroot starch raw materials come once a week according to orders from the company. Raw materials that come to the production department are directly weighed using a sitting scale. The results of weighing are recorded as incoming raw materials which are still done manually by filling out a check sheet provided by the company. However, the weighing check sheet owned by the company is still incomplete. There is no standard listed on the company check sheet and follow-up if the raw materials received are not in accordance with company standards.

Arrowroot starch raw materials from suppliers are in accordance with company standards. Raw materials received and meet the standard form for weighing raw materials will then be checked for the quality of raw materials. While the raw material for margarine comes from PT SMART with the *Plamboom* brand. The margarine that arrived had a total weight of 300 kg with a net weight of 15 kg per box or as many as 20 boxes. Margarine raw materials come once a month according to orders from the company. Margarine who came first was checked for completeness of documents such as Delivery Orders and travel documents. Margarine raw materials that come from suppliers are BPOM certified, FSSC 22000 certified, and halal certified. Margarine raw materials that arrive at PT Serelia Prima Nutrisia are not weighed because the margarine product's net weight is stated on the margarine packaging.

On the one hand, the importance of the design of private and official food/feed sampling plans should be emphasized. First, sampling of bulk raw materials must be done so that representative sample can be obtained, which is crucial for accurately determining quality and

safety parameters (Adame-Siles et al., 2020). Arrowroot starch raw materials that have been received will be inspected/checked and filled in with a raw material quality check sheet by QC. Raw materials that meet company standards as in Table 1 will then enter the next stage, namely raw material storage in the raw material storage warehouse. However, for raw materials that do not meet the standards as shown in Table 2, they will be returned to the supplier.

Table 1. Check sheet for checking the quality of raw materials as the standard.

Materials/Goods	Test Parameters	Results Test	Standard	Recommendation
Arrowroot Starch Shift: 1	Form	Powder	Powder	ACCEPTED
	Size	100 mesh	100 mesh	
	Smell	Normal	Normal	
	Flour Color	Dull white	White dull	
	Foreign object	There isn't any	There isn't any	
	Water content	15.5%	Max. 16%	
	Gel Properties	Smooth, supple, sticky	Smooth, supple, sticky	
	Gel Color	White	White	
Margarine Shift: 1	Smell	Typical	Typical	ACCEPTED
	Color	Yellow	Yellow golden	
	Texture	Soft	Soft	
	Foreign object	There isn't any	There isn't any	

Table 2. Check sheet for checking the quality of raw materials not as the standards.

Materials/Goods	Test Parameters	Results Test	Standard	Recommendation
Arrowroot Starch Shift: 1	Form	Coarse powder	Coarse powder	REJECTED
	Size	80 mesh	100 mesh	
	Smell	Musty	Normal	
	Flour Color	Dull brownish	White dull	
	Foreign object	There isn't any	There isn't any	
	Water content	15.5%	Max. 16%	
	Gel Properties	Smooth, supple, sticky	Smooth, supple, sticky	
	Gel Color	Dull	White	

Table 3. Comparison of quality requirements for arrowroot starch from PT Serelia Prima Nutrisia with SNI.

Criteria	Unit	PT Serelia Prima Nutrisia	SNI	Suitability
1	Circumstances			
1.1	Shape	-	Fine powder	Correspond
1.2	Smell	-	Normal	Correspond
1.3	Color	-	Dull white	Not correspond
2	Foreign object	-	No	Correspond
3	Fineness, pass 100 mesh sieve, w/b	%	There is no minimum standard	Correspond
4	Moisture content, w/b	%	Maximum 16	Correspond
			Corresponding	83.33 %
			Not correspond	16.67%

The raw material standards used by PT Serelia Prima Nutrisia are quantity and quality standards (packaging condition, color, shape, aroma, size, foreign matter, gel properties, gel color). Checking the quality of raw materials that are carried out is still very manual by carrying out physical checks without carrying out chemical and microbiological checks. However, the standard of arrowroot starch at PT Serelia Prima Nutrisia has never been compared with the quality requirements of arrowroot starch according to SNI. Therefore, it is necessary to compare the quality requirements of PT Serelia Prima Nutrisia arrowroot starch with SNI 3541-2014 as shown in Table 3.

Based on Tabel 3 conditions quality ingredients raw starch tubers arrowroot set by PT Serelia Prima Nutrisia already according to SNI 01-6057-1999 of 83.33% with percentage discrepancy by 16.67%. Margarine raw materials that come are not checked for the quality of raw materials. Margarine that arrives is only checked for suitability of the name of the ingredient, the name of the manufacturer, information on the nutrition table, checking the Certificate of Analysis of margarine and the expiry date listed on the package (Crespo et al., 2022). After checking, the margarine that complies with company standards is immediately stored in the raw material storage warehouse. Raw materials are stored in special warehouses for raw material storage so that they are not mixed with food additives or other goods (Schrijvers et al., 2020). In carrying out raw material storage, there are two officers who are allowed to enter and leave the raw material storage warehouse, namely QC and one officer from the dough section.

The raw material storage warehouse is located adjacent to the production site to facilitate the process of moving raw materials from the storage warehouse to production. Each raw material has specifications in storage depending on the size and quantity of raw materials and the place of storage. In addition, the storage of raw materials is influenced by several important aspects including storage space, temperature, storage time, storage area, packaging and labeling. Significant temperature fluctuation and low heat release efficiency in conventional energy storage floor heating systems, energy storage floor heating system (Yu et al., 2024). At PT Serelia Prima Nutrisia raw materials are stored at room temperature 25°C by placing arrowroot starch on a pallet which aims to prevent raw materials from direct contact with the floor. Arrowroot starch stored in storage warehouses has a maximum accumulation of 7 sacks and does not stick to the walls. The margarine is placed on a table covered with aluminum plates and not attached to the wall with a storage room that is clean, dry and the walls are not damp. Raw materials are stored if they do not pay attention to the storage layout which results in the expiry process of these raw materials getting faster (Sauri., 2015).

The raw material for arrowroot starch that arrives is usually for one week's supply so that the raw material that arrives is kept at the raw material storage warehouse for about a week at the latest. Meanwhile, for margarine raw materials, an order is made if the margarine stock remains for one week. PT Serelia Prima Nurtrisia margarine which comes once a month. The phenomenon that often occurs in the storage of raw materials is that they no longer pay attention to the important aspects listed in the SOP for storing raw materials (Salas-Valerio et al., 2022). Like not implementing a First in First out (FIFO) system where the first goods entered are the first goods used. This method is used to minimize the existence of products that have a short shelf life and can be processed beforehand. So that there are no expired raw materials in the raw material storage warehouse (Sulima et al., 2021). In addition, the phenomenon that often occurs is not labeling the raw materials to be stored, then not storing the raw materials in their place, for example for types of food that must be stored in the chiller but stored in the freezer. These models try to follow the FIFO rule at different valuation levels (Kogan et al., 2017). However previous studies have shown that these current models and applications do not fully guarantee which comes first. They also allow for deviations from FIFO that are not significantly permitted or physically impossible in practice and such deviations can accumulate

over time. These models and methods require a standard for estimating the consequences of FIFO violations preferably in a wide range of situations (Pedapudi & Rajasekar, 2023).

Raw material storage techniques can be done in bulk or in sacks. At PT Serelia Prima Nutrisia, arrowroot starch is stored using sacks, and it is stored in the raw material storage warehouse using the stacking method which is very important to note. The date of receipt of raw materials and the quality of materials is a material consideration in storing materials because the durability of materials is very limited. Improper storage management can cause damage to materials and can reduce the quality of the final product. Damage to raw materials can be in the form of physical damage or chemical and biological damage. Physical damage in storage can be a trigger for chemical and biological damage. Therefore, the physical properties of a material are very important to know before storing the material (Ramos-Martínez et al., 2020).

Table 4. Analysis suitability implementation of company SOP.

Aspect	Company SOPs	Implementation	Suitability
Weighing of raw materials	Balancing is carried out	Balancing is carried out	Correspond
Fill out the raw material weighing form	Form filling is done	No form filling	Not correspond
Checking the quality of raw materials	Checked	Checked	Correspond
Check list of raw material quality	Fill in the <i>check list</i>	Not filling out the <i>check list</i>	Not correspond
Raw material quality <i>check sheet</i>	Fill in the <i>check sheet</i>	Not filling out the <i>check sheet</i>	Not correspond
Raw material storage temperature	25°C	28°C	Not correspond
Storage time of arrowroot starch	1 week	10 days	Not correspond
Margarine storage time	1 month	1.5 month	Not correspond
Raw material storage room	Raw material storage warehouse	Raw material storage warehouse	Correspond
Storage position of arrowroot starch	Position on the pallet, not attached to the wall and a maximum of 7 stacks	Position on the pallet, not attached to the wall and a maximum of 7 stacks	Correspond
Margarine storage position	Position on an aluminum plated table and not attached to the wall	Position on an aluminum plated table and not attached to the wall	Correspond
Amount		Correspond	45.45%
		Not correspond	54.55%

The physical properties of these materials include moisture content, specific gravity, water activity, pile angle, material fineness, impact density, material compaction density, and so on. In addition, raw material storage facilities are also a factor in ensuring the quality of raw materials, it's just that access to the raw material storage warehouse at this company is quite narrow and slightly mixed with the production room so that there is an opportunity for



contamination and oxidation of raw materials (Sharma et al., 2023). The process of receiving and storing raw materials at PT Serelia Prima Nutrisia is carried out based on company SOPs. SOP is made as a QC reference in the process of receiving and storing raw materials (Anacleto et al., 2018). However, the implementation of receiving and storing raw materials is often not in accordance with company SOPs. Based on this, it is necessary to analyze the suitability of the process of receiving and storing raw materials with company SOPs as shown in Table 4.

Based on Table 4, the suitability of the process of receiving and storing raw materials with the company's SOP is 45.45%. While the discrepancy is 54.55%, which means that the process of receiving and storing raw materials is not in accordance with the company's SOP. It has been indicated that these foods are stable, with a shelf life greater than the raw material of origin (Ariza-Ortega et al., 2023). This discrepancy can be a factor in the poor quality of the raw materials used, so it is necessary to carry out further analysis in the form of a *fishbone diagram analysis*. Aspects that become obstacles and cause discrepancies are analyzed using a *fishbone diagram* as shown in Figure 2.

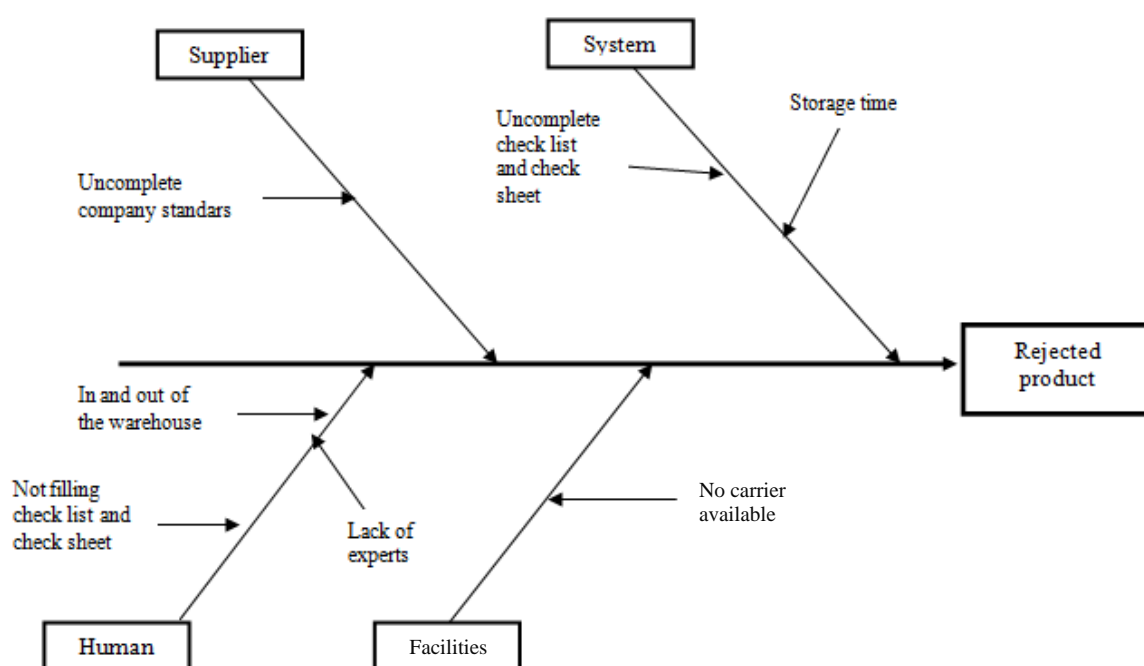


Figure 2. Fishbone diagram.

Based on the fishbone diagram (Figure 2), the spines with the smallest spines are shown in the human factor. So, the main cause of non-compliance with company SOPs comes from humans. The human factor is caused by three things, namely officers who often go in and out of the raw material storage warehouse which causes the room temperature to not comply with the SOP. The second factor is that the QC officers did not complete the checklist and check sheet and finally the lack of experts. Human resources at PT Serelia Prima Nutrisia can carry out self-development and attend training related to handling incoming raw materials and their storage. Besides that, receiving, quality checking, and storage of raw materials are carried out following the company's SOP.

#### 4. CONCLUSIONS

The process of receiving raw materials at PT Serelia Prima Nutrisia includes two processes, namely the process of weighing and quality checking in the form of shape, smell, color, packaging, and water content by QC. Storage of raw materials at PT Serelia Prima Nutrisia is carried out by taking into account the storage criteria for each raw material including

temperature, storage time, room, and storage position. The process of receiving and storing raw materials at PT Serelia Prima Nutrisia is not following the company's SOP.

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