

## Original Research Article

# ANALYSIS OF POTENTIAL HAZARDS FOR GADUNG CHIPS WORKERS USING THE HIRARC METHOD IN RINGINSARI VILLAGE, KEDIRI REGENCY

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## Abstract

**Background:** One of the industrial sectors that has a high risk of danger is the informal sector, one of which is the home industry of making chips. Knowledge about occupational health and safety is one of the factors that cause health problems and incidents in the workplace. Therefore, it is necessary to handle the problem of danger by identifying risks and controlling in minimizing the occurrence of accidents and occupational health disorders.

**Objectives:** The purpose of this research was to determine the risk of work accidents, determine the level of work accident risk and provide suggestions for controlling the risk of work accidents that can occur in the cassava chips manufacturing industry.

**Methods:** This study is a descriptive observational study, which is a research method that provides an in-depth description of the process of making gadung chips in a home industry which is then analyzed and compared based on existing reality. Observations are made directly to ensure that the process reflects daily practices in the home industry. The study was conducted with a cross-sectional approach, data will be collected at one time to understand the conditions at that time. The data analysis technique used in this study is descriptive analysis and risk identification with the HIRARC method, namely: 1) Hazard identification, 2) Risk Assessment (Risk Analysis), 3) Determining Controls, 4) Documentation Socialization and Implementing Controls

**Results:** 33 work accident risks were found that could occur in the process of making combined chips. The level of work accident risk from 33 risks obtained 42% low risk hazards, 21% medium risk hazards, 30% high risk hazards and 7% very high-risk hazards

**Conclusion:** Based on the research results, it can be concluded that: 1) 33 work accident risks were found that could occur in the process of making combined chips. 2) the level of work accident risk from 33 risks obtained 42% low risk hazards, 21% medium risk hazards, 30% high risk hazards and 7% very high-risk hazards. 3) there are 33 risk control studies consisting of substitution control, administration, and use of PPE

**Keywords:** *Informal Sector, HIRARC, Risk, Work accident*

## **INTRODUCTION**

The industrial world in Indonesia has developed from year to year. Industry and its products, both formal and informal, have positive and negative impacts on humans, on the one hand they will provide benefits, but on the other hand they can have negative impacts due to exposure to substances that occur in the work process or on the results of work. Several factors that can cause negative impacts are the potential for hazards in the workplace which include physical, biological, chemical, mental psychological factors, relationships between humans and machines or a less ergonomic work environment, inadequate work nutrition and other factors that cause work-related diseases and work accidents.

The informal sector is included in the economic and employment sectors that are widely found in developing countries including Indonesia, such as in manufacturing, trade, and agriculture both in urban and rural areas. Based on data obtained from the 2021 National Labor Force Survey of the Statistics Agency, the majority of the Indonesian population works in informal activities as much as 59.62%, and as much as 40.38% of the Indonesian population works in formal activities. Workers in the informal sector are mostly in rural areas 56.83%. The rate of accidents and occupational diseases in developing countries is four times higher than in industrialized countries. The International Labor Organization (ILO) in 2018 the rate of occupational accidents and occupational health and safety threats in Indonesia is still at a fairly high level. Industrial accidents in Indonesia in 2018 ranked the highest in Indonesia at 152 out of 153 countries surveyed (Rangkang et al., 2021). About a quarter of these deaths were caused by exposure to hazardous substances that cause disabling diseases such as cancer, cardiovascular disorders, respiratory disorders, and the nervous system. In addition, it was also noted that work accidents such as slipping, tripping, and falling are one of the most common causes of injury in the food manufacturing industry

and the workplace in general (Dewi and Ikhssani, 2021). The Gadung chips X home industry is one of the home industries known in the Ringinsari Village area, Kediri Regency.

The Gadung Chips X home industry has 6 employees and is capable of producing 11 to 15 quintals of Chips Gadung per day. The large amount of production produced by the number of workers often results in workers experiencing various health problems and work accidents. Based on the results of the interview, it was found that workers' hands and faces were often exposed to gadung sap during the peeling process because they did not use gloves and masks, so that their skin often became itchy and irritated. In addition, workers often work in an inappropriate body position due to limited facilities, so they often experience muscle pain and tingling. This incident is a concern because it shows the potential risk of work hazards. In addition, it was found that employees did not fully understand and apply the principles of occupational safety and health properly. Occupational safety and health is a field related to protecting the safety, health and welfare of people involved in work or work. The objectives of the occupational safety and health program include fostering a safe and healthy work environment. In developing countries, most accidents and occupational diseases occur in the informal industrial sector (Mock, et al, 2017). Lack of knowledge about occupational safety and health can be a determining factor in the occurrence of health problems and incidents in the workplace. Therefore, it is necessary to handle the problem of hazards in the workplace and appropriate control efforts, especially in the informal sector by identifying risks in minimizing the occurrence of accidents and occupational health disorders and ensuring that every step of production is carried out safely.

**Objective(s):** to identify the potential hazards in gadung chips using the Hazard Identification and Risk Assessment (HIRA) Method.

## METHODS

### *Study Design*

This study was a descriptive observational study, which is a research method that provides an in-depth description of the process of making gadung chips in a home industry which is then analyzed and compared based on existing reality. Observations are made directly to ensure that the process reflects daily practices in the home industry. The study was conducted using a cross-sectional approach, data will be collected at one time to understand the conditions at that time, including factors that can affect product quality and safety and allow researchers to identify potential risks and improvement efforts in the home industry of gadung chips

### *Setting*

This research was conducted in September 2024 in one of the areas in Malang City in the informal industrial area, namely the gadung chips industry.

### *Research Subject*

The population of this study was all employees of the gadung chips home industry.

### *Instruments*

This research is related to the occupational health and safety management system with the HIRARC method, namely:

- 1) Hazard identification
- 2) Risk Assessment (Risk Analysis)
- 3) Determining Controls (Determining control measures)
- 4) Documentation Socialization and Implementing Controls

### *Data Analysis*

The data analysis techniques used in this study are descriptive analysis and risk identification. Descriptive analysis is a statistic used to analyze data by describing or depicting data that has been collected as it is without the

aim of drawing general conclusions or generalizations. Risk identification is identifying or observing activities in the production department that have the potential to cause accidents and occupational diseases. The matrix used is based on the level of impact of consequences, exposure to potential hazards that occur.

### *Ethical Consideration*

In this research, an ethical feasibility test was carried out.

## RESULTS

Activities in the process of making gadung chips consist of 8 processes with various risks. Both those that have occurred or risks that have not occurred but can appear at any time.

The first activity in the process of making gadung chips is the reduction of materials in the form of gadung fruit which has 4 findings of the first type of hazard risk 1 high risk, 2 medium risks and 1 low risk. In the second activity, namely peeling and washing gadung, there are 5 findings of hazard risks, namely 1 high risk, 1 medium risk and 3 low risks. In the third activity, namely slicing gadung, there are 3 findings of hazard risks, namely 1 medium risk and 2 high risks. In the fourth activity, namely mixing gadung with gadung and salt, there are 5 findings of hazard risks, namely 1 high risk, 1 medium risk and 3 low risks. In the fifth activity, namely the marinating process, there are 3 findings of hazard risks, namely 1 high risk and 2 low risks. In the sixth activity, namely the process of drying gadung, there are 5 findings of hazard risks, namely 2 high risks, 1 medium risk and 2 low risks. In the 7th activity, namely the process of boiling gadung, there were 4 findings of hazard risks, namely 1 very high risk, 1 high risk and 2 low risks. In the 8th activity, namely frying gadung, there were 4 findings of hazard risks, namely 1 very high risk, 2 high risks and 1 low risk. And in the 9th activity, namely packaging gadung chips, there were 2 findings of hazard risks, namely 1 moderate risk and 1 low risk.

**Table 1. Results of the HIRARC Method**

No	Activity	Hazard and risk	L	C	R	Risk Level	Control proposal
1	Gadung Material Decline	Hit by a giant gadung	3	2	M	Medium	Use of tools in the form of a pushcart to assist in transportation
		Fell/slipped while unloading materials	2	3	M	Medium	Make a schedule for regular cleaning to prevent slippery floors. Use safety shoes
		Muscle pain injury after lowering material	4	2	H	High	Do stretching to reduce body aches
		Bitten/stung by insecs from gadung	2	1	L	Low	Use gloves/safety gloves when transporting materials
2.	Peeling and washing of gadung	Cut by knife	3	1	L	Low	Use gloves/safety gloves when transporting materials
		Itching due to exposure to gadung resin	4	2	H	High	Use gloves/safety gloves when transporting materials
		Bitten/stung by insecs from gadung	1	1	L	Low	Use gloves/safety gloves when transporting materials
		Muscle pain in the hands due to peeling large amounts of gadung	3	2	M	Medium	Do stretching before or after activities to reduce body aches.
		Slip	2	1	L	Low	Make a schedule for regular cleaning to prevent slippery floors. Use safety shoes
3.	Slicing gadung	Sliced or cut	4	1	M	Medium	Use gloves/safety gloves when peeling gadung
		Electric shock when turning on the slicing machine	1	5	H	High	Modifying a power outlet into a power outlet switch
		Noise from machine use	2	4	H	High	Replacing a diesel-powered engine with a dynamo-powered engine
4.	Mixing and soaking gadung with ash and salt (marination)	Ash dust allergy risk	1	2	L	Low	Using a mask and gloves
		Eye irritation due to ash dust	2	1	L	Low	Using safety glass
		Choking on ash dust (cough)	1	1	L	Low	Using a mask
		Muscle pain in the back and arms	3	3	H	High	Do stretching before or after activities to reduce body aches.
		Difficulty breathing	1	3	M	Medium	Using a mask
5	Drying gadung	hot climate	3	1	L	Low	Increased number of ventilation and cooling facilities
		Scratched basket	2	1	L	Low	Using a gloves
		Slip	3	3	H	High	Using safety glass
		Fallen	1	3	M	Medium	Use of ladders when drying in high areas
		Muscle pain in the back	3	3	H	High	Do stretching before or after activities to reduce body aches.

6	Boiling gadung	Exposed to smoke	2	1	L	Low	Use of masks and safety glasses
		Exposed to heat	3	1	L	Low	Use safety gloves or heat-resistant gloves
		Got burned	2	4	H	High	Use heat resistant gloves and an apron
		Gas explosion	2	5	E	Extream	Conduct regular checks on gas cylinders, regulators and hoses and provide training to workers on how to properly install gas cylinders.
7	Gadung frying	Exposed to heat	3	1	L	Low	Use heat resistant gloves and an apron
		Got burned	2	4	H	High	Use heat resistant gloves and an apron
		Gas explosion	2	5	E	Extream	Conduct regular checks on gas cylinders, regulators and hoses and provide training to workers on how to properly install gas cylinders.
		Muscle pain in the back	3	3	H	High	Do stretching before or after activities to reduce body aches.
8	Packaging of gadung chips	Scratched	2	1	L	Low	Using a gloves
		Muscle pain in the back and neck of the head	2	3	M	Medium	Do stretching before or after activities to reduce body aches.
		Stabbed	1	1	L	Low	Using a gloves

## DISCUSSION

### Low Risk Findings and Risk Assessment

There are 8 activities in the process of making gadung chips, 14 low-risk potential hazards were found consisting of the risk of being bitten/stung by pests from gadung, being bitten by knives, slipping, allergies, eye irritation and choking due to ash dust, exposure to hot climates, being scratched by baskets, being exposed to hot steam, and being stabbed. The risk of being bitten/stung by pests from gadung can occur when moving gadung from the truck to the storage area and when peeling/washing gadung. The gadung that is moved is gadung that is still dirty and has not been cleaned so that there is a high risk of pests such as caterpillars, worms and ants. Suryani (2019) in his research results stated that workers who experience bites from weaver ants, bees can experience quite serious injuries, so the proposed control that can be done is to use Personal Protective Equipment (PPE) such as gloves, masks, and safety boots on workers

so that workers can avoid pest attacks, which is presented in Table 2.

**Tabel 2. Low Risk Findings and Risk Assessment**

L	C	Scale	Data
2	1	2	Low
3	1	3	Low
1	1	1	Low
2	1	2	Low
1	2	2	Low
2	1	2	Low
1	1	1	Low
3	1	2	Low
2	1	2	Low
2	1	3	Low
3	1	2	Low
3	1	2	Low
2	1	3	Low
1	1	3	Low

Moving gadung by workers also carries the risk of falling and slipping. In his research, Suryani (2019) explained that harvesters who do not use complete PPE such as boots and gloves, this can cause work accidents such as feet being pierced by palm thorns, slipping and

other things. In addition, harvesters who get dust in their eyes when harvesting, this is because harvesters do not use glasses as PPE. So there needs to be regulations regarding the use of PPE to reduce these risks (Danamik, 2024).

**Moderate Risk Findings and Risk Assessment**

Based on the research results of 8 activities in the process of making gadung chips, 7 potential moderate risk hazards were found consisting of the risk of being hit by gadung, falling, being cut and respiratory disorders which are presented in Table 3.

**Tabel 3. Moderate Risk Findings and Risk Assessment**

L	C	Scale	Data
3	2	6	Medium
2	3	6	Medium
3	2	6	Medium
4	1	4	Medium
1	3	4	Medium
1	3	4	Medium
2	3	6	Medium

The risk of respiratory disorders can occur during the gadung marinating process and during the boiling of gadung. The gadung marinating process uses a body in the form of ash and salt, dust from the ash can interfere with workers' breathing while in the boiling process, smoke from the use of firewood can also cause workers to experience shortness of breath. Aini (2015) in her research explained that particles that enter the body can cause diseases that reduce lung capacity (respiratory disorders) so that the proposed control that can be given is the use of Personal Protective Equipment (PPE) in the form of masks and safety glasses. Likewise, the risk of being hit by gadung, falling and being cut. Suryani (2019) explained that harvesters who do not use complete PPE such as boots and gloves, this can cause work accidents such as feet being pierced by palm thorns, slipping and other things.

**High Risk Findings and Risk Assessment**

Based on the results of the study of 8 activities in the process of making gadung chips, 10 potential high-risk hazards were found consisting of the risk of muscle pain injuries, itching allergies, electric shocks, burns and noise. There is a risk of muscle pain in the back due to the activity of moving gadung from the truck to the gadung storage area, peeling/washing gadung, marinating, drying and packaging gadung chips. Every day workers move 11-15 quintals of gadung to be produced, considering the large and large amount of gadung that must be moved and produced, so that there is a high risk of workers experiencing muscle pain, especially in the back area. This is in accordance with the results of the study by Anggarani et al. (2022) which states that muscle fatigue is due to excessive muscle contraction and can inhibit the supply of oxygen to the muscles. So based on this, one of the proposed controls that can be given is administrative control by stretching/warming up before moving gadung. High hazard risk data can be seen in Table 4.

**Tabel 4. High Risk Findings and Risk Assessment**

L	C	Skala	Data
4	2	8	High
4	2	8	High
1	5	5	High
2	4	8	High
3	3	9	High
3	3	9	High
3	3	9	High
2	4	8	High
2	4	8	High
3	3	9	High

In addition, there is another high risk of electric shock and burns. The risk of electric shock can occur in the activity of slicing gadung, where the slicing tool uses an electric-powered machine. The pinfirisan area is close to a water source so that there is a high risk of workers being electrocuted and experiencing burns. Campbell (2017) said that the incidents of electric shock and fire were caused by poor

electrical installations so that the proposed control that can be given is to modify the contact stop into a power outlet switch so that it will be safer.

Another finding of high hazard risk is noise. Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 70 of 2016, the determination of the Threshold Limit Value (NAB) for noise levels in the workplace in Indonesia is 85dB with an exposure time of 8 working hours, while from the results of the study it was found that the measurement results obtained NAB more than 85 dB which was caused by the use of slicing machines that still use diesel-powered engines. Based on the research results of Prayoga, et al (2023) stated that if the noise level exceeds the NAB, then the proposed control that can be carried out is substitution control by replacing the engine from a gasoline engine to a dynamo-powered engine. In addition, it can also be done with PPE control such as using ear plugs.

**Very high-risk findings and risk assessment**

Based on the research results of 8 activities in the process of making cassava chips, 2 potential hazards with very high risks were found, namely gas explosions, which can be seen in Table 5.

**Table 5. Very High-Risk Findings and Risk Assessment**

L	C	Skala	Data
2	5	10	<i>Extreme</i>
2	5	10	<i>Extreme</i>

In the process of boiling gadung there are 2 types of boiling tools, namely using gas and using firewood which are adjusted to the conditions of the needs. Boiling using gas cylinders has a high risk of gas leaks which can cause explosions. According to Roihan et al (2016) installation of gas cylinders that do not comply with the provisions can cause leaks which can result in explosions; therefore, it is necessary to conduct training on the installation and checking of gas cylinders so as not to cause

danger. The proposed control that can be given is administrative control in the form of providing education to each worker on how to install gas cylinders properly and correctly and checking gas cylinders regularly.

**CONCLUSION**

Based on the research results, it can be concluded that: 1) 33 work accident risks were found that could occur in the process of making combined chips. 2) the level of work accident risk from 33 risks obtained 42% low risk hazards, 21% medium risk hazards, 30% high risk hazards and 7% very high-risk hazards. 3) there are 33 risk control studies consisting of substitution control, administration, and use of PPE (Personal Protective Equipment).

**SUGGESTIONS**

Based on the research results above, it is very important to carry out occupational safety and health analysis, especially for informal workers, periodically, as seen from the many findings of hazard risks from the gadung chips manufacturing process, including low, medium, high and very high hazards.

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**DECLARATION OF CONFLICTING INTEREST**

There was no conflict of interest in the implementation of this research.

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## AUTHOR CONTRIBUTION

**Riza Irianingtyas:** Collected literature, collected data, tabulated the data and coding, searched for the questionnaire, compiled manuscripts and conducted data analysis

**Ellyza Setya Maryiantari:** Compiled health education materials, collected data and compiled manuscripts.

**Tigowati:** Compiled health education materials, collected data and compiled manuscripts.

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