

ETHNOSCIENCE ANALYSIS OF TRADITIONAL LIQUID PALM SUGAR PRODUCTION IN ACEH AS A CONTEXTUAL SCIENCE LEARNING RESOURCE

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ABSTRACT

Aceh's traditional manufacturing of liquid palm sugar shows indigenous knowledge that includes a number of scientific ideas pertinent to science education. The purpose of this study is to evaluate the potential of traditional liquid palm sugar manufacturing as a contextual science learning tool and to analyse the ethnoscientific elements that are present in it. Through observation, documentation, and a review of the literature, this study employed a qualitative descriptive method among Acehese traditional palm sugar production villages. The findings demonstrated that the activities involved in the production process—sap collecting, filtering, heating, concentration, caramelisation, and cooling—reflect scientific ideas related to plant physiology, heat transport, evaporation, and chemical change. Local communities use empirical knowledge passed down through the centuries to regulate product quality, processing time, and temperature. Students' conceptual grasp and respect of local culture can be enhanced by incorporating ethnoscience into science education. Consequently, there is a good chance that traditional liquid palm sugar manufacturing will develop into a contextual and culturally sensitive science teaching tool.

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INTRODUCTION

Since science education should link scientific ideas to students' everyday lives and cultural experiences, ethnoscientific analysis of traditional liquid palm sugar manufacturing in Aceh as a contextual science learning resource becomes crucial. Students struggle to comprehend scientific concepts in a meaningful way since science is still taught abstractly in many schools and sometimes ignores local cultural factors (Parmin et al., 2020). Students can connect scientific ideas with actual phenomena in their surroundings by using contextual learning based on local knowledge (Komalasari, 2017).

Indigenous knowledge systems that incorporate scientific principles derived from cultural practices and community experiences are referred to as ethnoscience (Khoiri & Sunarno, 2020). According to earlier research, ethnoscience-based education enhances students' critical thinking abilities, scientific literacy, and learning engagement (Sudarmin et al., 2019). According to Rahmawati and Taylor (2018), students' learning identities and respect of local knowledge are strengthened when culture is incorporated into science instruction. Additionally, Kim and Dionne (2019) highlighted that as traditional practices frequently incorporate sound scientific principles, indigenous science should be incorporated into official science education.

The purpose of this study is to determine the steps of traditional liquid palm sugar manufacturing in Aceh, investigate its potential as a contextual science learning resource, and analyse the scientific concepts ingrained in each stage from an ethnoscientific perspective. Through direct observation and documentation, a qualitative descriptive method was employed in this study. The results show that every level of manufacturing exhibits both local factual knowledge passed down through the ancestors and scientific ideas pertaining to chemistry, physics, and biology.

Science learning concepts including heat transmission, evaporation, solution concentration, filtering, and chemical changes can be supported by contextual examples from traditional liquid palm sugar manufacturing. Incorporating local culture into science education enhances students' cultural awareness and preserves local knowledge in addition to improving conceptual understanding (Arfianawati et al., 2016). Thus, ethnoscience-based science education can produce educational experiences that are both culturally sensitive and meaningful.

RESEARCH METHODOLOGY

Because the goal of the study was to comprehend local knowledge and cultural practices linked to traditional liquid palm sugar manufacturing in Aceh, a qualitative descriptive research approach was utilised (Creswell & Poth, 2018). Investigating indigenous knowledge systems and deciphering scientific ideas ingrained in social behaviours are good uses for qualitative research (Sugiyono, 2022).

The study was carried out in Acehese communities that had long produced liquid palm sugar. The research subjects were traditional sugar processors and palm sap collectors who were purposefully chosen based on their expertise in sugar production (Creswell & Creswell, 2018). All phases of conventional liquid palm sugar manufacturing were included in the study's objectives.

Techniques for gathering data included literature reviews, documentation, and observation. The procedures of sap tapping, filtering, heating, concentration, and cooling were all directly witnessed by researchers. Photographs and field notes were utilised to document the community's usage of local terminology, production methods, and empirical knowledge (Nowell et al., 2017).

Interactive qualitative analysis, which includes data reduction, data display, and conclusion drafting, was used to analyse the gathered data (Miles et al., 2018). Production steps and related scientific ideas were used to classify the data. After that, ethnoscientific viewpoints were used to evaluate the data in order to relate local customs to scientific learning principles.

RESULT AND DISCUSSION

Stages of Traditional Liquid Palm Sugar Production

The results showed that a number of methodical steps, including sap collection, filtering, heating, concentration, caramelisation, and cooling, are involved in the traditional production of liquid palm sugar in Aceh. Simple conventional tools and regional methods passed down through the centuries are used to carry out these tasks. The community's activities mirror scientific ideas that have been created via practical experiences, even if they do not specifically utilise scientific terminology (Khoiri & Sunarno, 2020).

To get the best sap quality, palm sap is often collected in the early morning and late afternoon. Understanding plant metabolism and how the environment affects sap production is reflected in this practice (Rahmawati et al., 2019). Then, using basic filtering materials like cloth or bamboo filters, the collected sap is filtered to eliminate contaminants. This procedure exemplifies the scientific idea of filtration-based mixture separation (Tro, 2020).

Wood-fired stoves are used to continuously heat the filtered sap while stirring it frequently to prevent burning. Conduction and convection mechanisms carry heat energy from the stove to the container and sap during heating (Bergman et al., 2020). The water content steadily evaporates as the heating process proceeds, thickening the solution. This step illustrates the concentration and evaporation processes that are frequently covered in science classes (Tro, 2020).

The sap turns from light brown to dark brown and releases a unique scent when heated for an extended period of time. Caramelisation, a chemical reaction brought on by heat exposure to sugar molecules, is indicated by this process (Damodaran & Parkin, 2019).

Before being stored, the liquid sugar is allowed to cool naturally after it reaches the appropriate consistency.

Ethnoscience Analysis of Scientific Concepts

This study's incorporation of ethnoscience demonstrates how scientific knowledge is embodied in traditional activities. According to Table 1, the results verify that every phase of the synthesis of liquid palm sugar aligns with important scientific ideas.

Table 1. Ethnoscience Analysis of Liquid Palm Sugar Production

Production Stage	Local Practice Description	Scientific Concept
Sap Collection	Tapping palm trees at specific times	Plant physiology, metabolism
Filtration	Using simple filters to remove impurities	Separation of mixtures
Heating Concentration	Boiling sap over fire Thickening through prolonged heating	Heat transfer, temperature Evaporation, solution concentration
Color Change	Sap turns brown and aromatic	Caramelization, chemical change
Cooling	Product stabilization	Temperature change, material stability

According to the findings, traditional knowledge systems have practical comprehension and scientific reasoning that are consistent with formal science notions. Sudarmin et al. (2019) showed similar results, explaining how ethnoscience-based learning successfully connects scientific ideas with regional cultural experiences. Therefore, rather than being merely cultural traditions, indigenous practices should be regarded as important educational tools.

Relevance to Contextual Science Learning

According to the results, traditional liquid palm sugar manufacturing could be a useful tool for contextual scientific education. When scientific theories are linked to actual cultural practices observed in their immediate surroundings, students are better able to comprehend abstract notions (Komalasari, 2017).

Students' scientific literacy and cultural understanding are also enhanced by ethnoscience-based education. Students gain an appreciation for local culture and community knowledge in addition to learning scientific topics when local wisdom is incorporated into classroom activities (Rahmawati & Taylor, 2018). This method is in line

with culturally sensitive education, which promotes inclusive and significant learning opportunities.

Additionally, by making learning materials more applicable to their everyday experiences, the incorporation of local contexts in science education might boost student motivation and engagement (Parmin et al., 2020). Thus, there is a great chance that traditional liquid palm sugar manufacturing will help Indonesian science education be contextual and culturally sensitive.



Figure 1. a) Cooking sugarcane juice, (b) Filtering impurities, (c) Finished sugar, (d) Red sugar that continues to thicken

The results of this study show that traditional liquid palm sugar manufacturing is in line with ethnoscientific principles and has a wealth of scientific substance. The information provides compelling evidence for the claim that implicit scientific knowledge found in local knowledge systems can be methodically examined and incorporated into formal education. This study also emphasises how crucial it is to close the knowledge gap between conventional and contemporary science education. Teachers can establish more inclusive and culturally sensitive learning environments by integrating ethnoscience into the curriculum. This method encourages respect for local knowledge while simultaneously enhancing pupils' scientific literacy. The lack of quantitative assessment during the production process is one of the study's acknowledged weaknesses. To strengthen the scientific validation of traditional practices, it is advised that future study integrate experimental methods with qualitative ethnoscience analysis

CONCLUSIONS AND SUGGESTIONS

Rich ethnoscientific values that are intimately linked to science ideas in biology, chemistry, and physics are found in Aceh's traditional liquid palm sugar production. Sap collection, filtration, heating, evaporation, caramelisation, and cooling are all steps in the production process that are based on actual scientific knowledge passed down through the

generations. These results suggest that local cultural customs can be useful tools for contextual science education.

Students' conceptual comprehension, scientific literacy, and respect for local knowledge can all be enhanced by including ethnoscience into science education. In order to produce relevant, contextual, and culturally sensitive educational experiences, educators are encouraged to include local cultural traditions into science learning activities.

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