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Indigenous technology in utilizations and handlings of palmyra palm (*Borassus flabellifer* L.) sap and its quality from two regions of East Java

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Abstract. Indigenous technology in utilizations and handling of palmyra palm sap were studied in two regions of East Java, i.e at Gunungsari village, Beji, Pasuruan, and at two districts in Sumenep, Madura, which were known as one of palmyra palm plantation centre in East Java. Field observations and interviews were carried out to some farmers that taken by purposive sampling. Result of this research shows that there were differences in utilization and handling of sap between two regions. All of farmers in Gunungsari utilize sap in fresh sap called *legen* as their produce, and some fermented sap, wine called *toak* and further fermented as vinegar. On the other side, farmers in two districts in Sumenep, 96.7 % at Pragaan and 100 % at Dungkek process their palmyra palm sap into jaggery or palm sugar, this is due to high production of sap in this region as Sumenep still has high palm population. At Gunungsari, farmers preserve sap by boiling fresh sap after four hours tapping process if they do not need to ferment it to wine or vinegar. In Sumenep, according to sap utilization as palm sugar, they preserve the sap by adding sap a pinch of gum-lack tree (*Schlechera oleosa*) bark or cashew (*Anacardium occidentale*) leaves during tapping. Analyses of sap samples from two regions taken in wet season showed that total soluble solid contained were not significantly difference, it ranges from 9.47 until 11.67 brix. Reducing sugar contained in sap from Sumenep was the lowest, i.e 0.67 % compared with those at Gunungsari 2.10% for fresh and 2.04% for boiled sap. Sap preserved by adding gum-lack tree bark had higher total soluble solid and reducing sugar than the boiled one. The tapping, collecting, utilizations and handling of palmyra palm sap in two regions still carried out traditionally, technology innovations are urgently needed in these regions.

1. Introduction

Palmyra palm (*Borassus flabellifer* L.) or toddy palm is dioecious palms of the family Palmae or Arecaceae [1]. Genus *Borassus* is one of the most widely distributed plant of the *Arecaceae*, from western Africa to eastern Indonesia [2]. In Indonesia, palmyra palm highest populations are in East Nusa Tenggara, East Java and South Sulawesi [3]. Sumenep, Madura is one of palmyra palm centre in East Java with population about 5.535.700 trees spread in 24 districts [4]. Although there is lowering tree population as increasing development of industries in Gunungsari, the village is still well known as fresh palmyra palm sap producer.

The fresh sap of palmyra palm, called *nira* (Indonesian), *legen* (Javanese), and *laáng* (Madurese), contains about 10.93% total sugar and 0.96% reducing sugar [2]. Freshly tapped

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palmyra sap collected from inflorescence was transparent without any colour, less viscous and the pH was ranging between 7-7.4 and near to neutral [5]. In its natural fresh state, the sap can be drunk immediately, and posses a sweet and pleasant taste. However, rapidly fermentation occurs and within hours the sap becomes a mild palm wine with an alcohol content of 5-6% then was referrer as palm toddy [2]. Besides uses as beverage, toddy has numerous medicinal properties, and it is used as leavening agent in bread making because of its yeast content [2]. Palmyra sap also can be boiled down into syrup or crystallized into a palm sugar called jaggery [2]. Palm jaggery preparation starts with tapping process, then preservation of sap with lime, and clarification within heating process [6]. Different palmyra producing regions maybe show different utilizations of sap, so also different in its handling.

The purpose of this study was to learn the difference of indigenous technology in utilizations and handlings of palmyra palm sap between two regions of Gunungsari and Sumenep in East Java. The result of this field surveys is description of the indigenous technologies which is very important for further study in improving suitable technologies in two regions.

2. Experimental Method

A qualitative descriptive research was held to study about indigenous technology in utilization and handling of palmyra palm sap in two regions in East Java, Indonesia. Gunungsari, is a village at Beji district in Pasuruan which was used as centre of palmyra palm plantation. Then, Sumenep is currently has the highest palmyra plantation in East Java [7]. Field observations and interviews were carried out to 30 people or farmers in each village or district that taken by purposive sampling in Gunungsari and two districts i.e Pragaan and Dungkek in Sumenep, Madura in order to earn quantitative data of utilizations. Deep interviews were held by asking government officer to select farmers to be interviewed.

Sap samples from those two places were analyzed for total soluble solids (TSS) and for reducing sugars contained in sap. Samples were taken in wet season on February 2018. Samples from Gunungsari were comprises of three sources as replications of fresh sap and cooked sap taken from farmers. From Sumenep, samples were prepared as cooked sap also of three sources as replications and single sample from sap that preserved by gum-lac tree bark. All samples were traditionally prepared by farmers. Total soluble solids were measured by Atago refractometer and reducing sugars by method of Nelson-Somogyi with Shimadzu spectrophotometer.

3. Results and Discussion

Utilization

Result of the research showed that all of 30 farmers (100%) interviewed at Gunungsari, Beji, Pasuruan always sell or drink fresh sap (Fig. 1 b.) as beverage,. They do not process their sap into jaggery, as fresh sap has given high economic value for them. Some people nearby have had been customers for the fresh sap as they believe that the sap may cure some diseases. Fresh sap is fast deteriorate and fermented into palm wine called *toak*, then further fermented into vinegar. Within hours after tapping, fresh sap starts to ferment, and farmers whom keep fresh sap as beverage must boil it to lengthen sap life time after 4 hours. Many farmers at Gunungsari let their sap fermented to produced vinegar, as vinegar also has high economic value as beverage. They sell vinegar to *legen* seller on the street or market who make it as beverage that composed from 25 liters water every 1.5 liters vinegar and add with sugar, not ordinary fresh sap (Fig. 1c.). A large part of sweet taste from the fresh sap is mainly derived

from fructose and glucose, and the sour taste may be due to the variety of organic acids which are generated by spontaneous fermentation [8].

In Sumenep, almost all of samples (96.7%) interviewed in Pragaan and 100 % in Dungkek process their sap into jaggery, which called *gelelih*, one of them has tried to make granulated palm sugar that guidance by government official (Fig. 1 a). There were two kinds of jaggery, the brown one and the other was rather bright in colour. The bright one was processed and finished directly in the same day and clarified twice or more in order to get a good result. The brown one were processed in two steps, first step was boiled sap into sugar syrup and was kept until someday they boiled the syrup and crystallized it as brown jaggery. Some of them also sell fresh sap in limited amount due to low demand from consumers compared with high sap production.



Figure 1 (a)Various kind of jaggery processed in Sumenep, (b) fresh sap from Gunungsari, (c) *legen* processed of mixture vinegar, water, and sugar

Handling

At the onset of maturity, palms are about 10 meters high, but by the final stages of life can attain 25-30 meters high [6]. The first flowering takes place when the palm is 12-20 years of age [2]. In tapping of palmyra inflorescences, farmers or tappers must possess technical skill, physical strength and agility to climb tall palms. At Gunungsari, they usually use the traditional bamboo ladders that attached permanently to palm trunk for safer climbing. In Sumenep, in order to easier and safer climbing the palms, they make some footsteps by cutting wood surround the trunk. High risk is faced by all tappers in climbing the tall palms. Both at those two regions, accidents often occurs to them, which are caused invalid or death.

Farmers of both two regions tap their trees twice a day, in the morning and in the evening. They tap the tree everyday, although in wet season the tree produce much lower than dry season. Sap in wet season has lower quality as sometimes it mixed with rain water and debris. Farmers at Gunungsari contain their sap in bamboo tube called *bumbung* or *bonjor* during tapping, but farmers from Sumenep use plastic pail or palmyra palm leaves as containers of their tree sap. At Gunungsari, tapper covers the bumbung in order to get fresh sap free from rain water and debris, but in Sumenep, they do not cover the pails, as they directly boiled the sap for making jaggery.

Different handlings of sap in two regions due to different utilizations as discussed above. Sap that is using freshly does not given any treatment during tapping, in order not effecting flavor and taste. Preservation will be carried out if it must keep longer than four hours by boiling or cooling the sap (Fig. 2a). On the other side, in making jaggery, preservation must start from tapping process. In Sumenep, farmers add a pinch of gum-lac tree (*Schlechera*

oleosa) or cashew (*Anacardium occidentale*) leaves on the base of their tapping container (Fig. 2b). Fermentation of palmyra sweet sap occurs during the period of collection right up to processing. Traditionally, people in Sri Lanka [1] and India [6] use lime to prevent the fermentation.

Good palmyra palm sap for jaggery process is at about neutral in acidity, above pH 6, as sucrose crystallize on pH above 5.5. Hydrolysis reaction, inversion of sucrose into fructose and glucose occurs in acid condition [8]. Lowering in sap acidity is generally caused by micro organism dominated by yeasts, particularly *Saccharomyces cerevisiae* [1].



Figure 2. Traditional sap preservation, (a) boiled fresh sap (Gunungsari) and (b) adding a pinch of gum-lack tree bark during tapping (Sumenep)

Total soluble solids (TSS) and reducing sugar

Table 1 shows that total soluble solid from two regions in East Java did not significantly difference, it ranges from 9.47 to 11.67 brix. Boiled sap from Gunungsari has the lowest total soluble solid, maybe due to increasing in viscosity during boiling the sap and part of it clinking to the wall of cookware and did not poured to sample container.

From the total sugars estimated in the freshly tapped palmyra palm sap, around 86% is non reducing sugar, of which majority is sucrose, and about 13% is reducing sugar [5]. Nutritionally rich palm sap contains 11.36% of total sugar and 0.96% of reducing sugar, protein, nitrogen, phosphorus, mineral ash, iron and vitamins [5]. In this research, reducing sugar in sample collected were range from 0.67 to 2.10 %. Boiled sap from Sumenep has the lowest reducing sugar of 0.67%. Adding gum-lac tree bark in fresh sap tent to gave higher reducing sugar than the boiled one. Higher reducing sugar in fresh and boiled sap from Gunungsari shows that it sweeter than those from Sumenep, so it has better quality for beverages. This fact may also has implication to utilization besides other factor.

Table 1. Total soluble solid (TSS) and reducing sugars of Palmyra palm sap from two regions taken in wet season

Treatments	Total soluble solid (Brix)	Reducing sugars (%)	
Fresh sap (Gunungsari)	11,67	2,10	b
Boiled sap (Gunungsari)	9,47	2,04	b
Boiled sap (Sumenep)	11,53	0,67	a
HSD 5%	ns*	1,37	
Fresh sap preserved with Gum-lac tree bark	13,00	1,26	

*ns: no significant difference

4. Conclusion

Result of this research shows that there were differences in utilization and handling of sap between two regions. All of farmers in Gunungsari utilize sap in fresh sap called *legen* as their produce, and some fermented sap, wine called *toak* and further fermented as vinegar. On the other side, farmers in two districts in Sumenep process their palmyra palm sap into palm sugar or jaggery, this is due to high production of sap in this region as Sumenep still has high palm population. At Gunungsari, farmers preserve sap by boiling fresh sap after four hours tapping process if they do not need to ferment it to wine or vinegar. In Sumenep, according to sap utilization as palm sugar, they preserve the sap by adding sap a pinch of gum-lack tree bark or cashew leaves during tapping. Analyses of sap samples from two regions taken in wet season showed that total soluble solid contained were not significantly difference, it ranges from 9.47 until 11.67 brix. Reducing sugars contained in sap from Sumenep was the lowest, i.e 0.67 % compared with those at Gunungsari 2.10% for fresh and 2.04% for boiled sap. Sap preserved by adding gum-lack tree bark gave higher total soluble solid and reducing sugar than the boiled one. The tapping, collecting, utilizations and handling of Palmyra palm sap in two regions still carried out traditionally, technology innovations are urgently needed in these regions.

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