Evaluation of the Capabilities of Various Local Bamboo as the Places of Milk Fermentation without Inoculant of Lactic Acid Bacteria

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Abstract. This research was conducted to evaluate the capabilities of the various local bamboos without the inoculation of lactic acid bacteria (LAB) in milk fermentation. The method used in this study was completely randomized design (CRD) with three treatments, namely D (*delepung* bamboo); A (*ampel* bamboo) and T (*tali* bamboo). The results of the study showed that fermentation in *tali* bamboo produced the lowest pH value (4.82) followed by *ampel* bamboo (4.87) and *delepung* bamboo (4.97). Low pH values were followed by a high total acidity with the results respectively 0.82%; 0.80% and 0.78%. Similarly, the highest level of product consistency was in *tali* bamboo treatment (1.08 min) followed by *ampel* bamboo (0.53 min) and *delepung* bamboo (0.38 minutes). Product moisture content was also the lowest in *tali* bamboo treatment (87.28%) followed by *ampel* bamboo (87.53%) and *delepung* bamboo (88.70%). Never the less the capability of *tali* bamboo as a natural incubator is not significantly different to delay *delepung* bamboo and *ampel* bamboo reviewed from protein percentage and fat product. While the total LAB found in the product of *tali* bamboo treatment (5.82 x 10^4 CFU/g) was significantly more than *delepung* bamboo (1.60 x 10^4 CFU/g) and *ampel* bamboo (2.37 x 10^4 CFU/g). The conclusion of research was that the ability of the performance of LAB powder allegedly found in bamboo and its function of milk fermentation was more dominant on *tali* bamboo

Key Words: local bamboo, cow milk, fermentation technology, lactic acid bacteria

Introduction

It has been proven that the quality of fermented milk products is capable of providing better health values for people who consume it regularly. Fermented milk contains potential probiotic (Nagpal et al., 2007) and provides functional value to human. Probiotic contains LAB which if consumed regularly will improve the digestive tract and reduce the presence of pathogenic bacteria in the body. The dominance of LAB in probiotics such as yogurt is an important indicator of hygiene products and to spur its population in human gut that consume them (Mckinley, 2005). Accordingly, the demand of fermented milk products has increased in Indonesia. Various attempts were made to enrich the repertoire of these products by developing a variety of fermented milk product diversity. In the areas of West Sumatra and Jambi, attempts to modify fermented milk are performed by using bamboo tubes as natural incubator. The product is known as "dadih". “Dadih” produced in this area uses buffalo milk as raw material and microorganism that ferments the buffalo milk was from natural inoculants without additional starter and the types of microbes that work in the fermentation process are assumed to derived from *ampel* bamboo tube powder (Zakaria et al., 1998). This was also supported by Surono (2004) who observed the proportion of LAB in “dadih” from Bukit Tinggi and Padang Panjang (Indonesia), with domination of LAB strain *Lactobacillus sp, Lactococcus* and *Leuconostoc sp*.

The utilization of powder from *ampel* bamboo as performed by the Sumatrans, should be evaluated for possible implementation in other areas. In addition, it is important to evaluate the potential powder from a variety of local bamboo as a source of LAB starter and its effect on the quality of fermented cow milk. Thus, assessment on the potential of powder from variety of local bamboo (*delepung*, *ampel* and *tali* bamboos) needs to be performed, considering the population of these bamboos in Indonesia and particular in Bali. The success of the research can also efforts to modify the taste of milk fermented products to be significant to the local bamboo. Based on the explanation above, it is crucial to do research to evaluate the performance of local bamboo (*delepung, ampel* and *tali* bamboos) in the milk fermentation process without any additional inoculants.

Materials and Methods

The material used in this study was fresh cow milk and bamboo species of *delepung*, *ampel*, and *tali* each measuring 25 cm long. Materials required for chemical analysis were alcohol 70%, distilled water, 0.1 N NaOH, and MRS medium Peptone solution (bacteriological peptone).

The method used in this study was Completely Randomized Design (CRD) with three treatments, namely D (*delepung* bamboo); A (*ampel* bamboo) and T (*tali* bamboo), each treatment was repeated 3 times. The three bamboos were prepared for the fermentation containers, each measuring ± 25 cm long for 1 liter of milk capacity. The part of the bamboo was cut on both sections to maintain the powder. Fresh cow milk was pasteurized at 90^{o}C for 15 min, then the temperature was decreased up to 43^{o}C. The milk was poured into the bamboos whose hole was closed with old dried banana leaves, then the bamboos were preserved at room temperature for 18 hours.

Variables that were evaluated included the pH value (AOAC, 1995), the amount of moisture, protein, fat, total lactic acid according to the method by Sudarmadji et al. (1984) and total LAB according to Hadioetomo (1994). The research was conducted at the Laboratory of Animal Product Technology and the quality of fermented milk was examined at Laboratory Animal Food Chemistry, Faculty of Animal Science, Udayana University. The data was analyzed by variant analysis and in case significant differences existed would be continued with Duncan test (Steel and Torrie, 1993).

Results and Discussion

The pH value of fermented milk products is important factor to evaluate the quality of fermented milk products. Based on the research results (Table 1), the fermentation of cow milk in *delepung* bamboo tube produced the highest pH values compared to *ampel* and *tali* bamboos. The result of pH from *tali* bamboo was the closest value to the ideal pH of fermented milk which is 4.5 (Widodo, 2003). The high pH value from these three types of bamboo proved that fermentation of cow milk in bamboo still required additional LAB, despite the potential LAB bamboo powder (Zakaria et al., 1998). The results of this study also proved that the expected number of LAB cells was still low in all three types of bamboo, as obviously seen from the high pH value. pH value of fermented milk products is known as low pH value with a high acidity level (Miwada et al., 2006).

LAB was not inoculated in this research. Pure performance bacteria allegedly contained in bamboo powder were evaluated through a total approach to product acidity. The results showed that the total acidity of the fermented milk product in *delepung* was the lowest ($P <0.05$) compared to the other 2 treatments (Table 1). The acidity percentage of fermented milk products was still below the ideal standard namely 0.85 to 0.95% (Widodo, 2003). When compared to the ability of these three types of bamboo tube in assisting the process of fermentation, the fermentation of cow milk in a *tali* bamboo tube produced product acidity closest to the standard. The low acidity of the fermented milk product in the three types of bamboo is also evidenced by high pH values in all three treatment products. This was presumed due to the limited performance of pure LAB from the three types of powder found in the bamboo. However, the performance of bacteria in *tali* bamboo powder was better than *delepung* and *ampel*. The existence of these bacteria has been proved by Surono (2004) and Savadogo et al. (2004) observing the proportion of LAB in "dadih" products in which the fermentation process previously took place in a bamboo tube. Further mentioned that the proportion of the number of bacteria in the curd products include *Lactobacillus* (32%), *Leuconostoc* (30%), *Lactococcus* (20%), *Leuconostoc-bacterium* (10%), *Streptococcus* (6%) and *Enterococcus* (2%).

Viscosity of fermentation products is also an important indicator to measure the quality of fermented products. Products viscosity was evidence that the fermented milk had a positive biodegradation experience with the degradation of milk lactose into lactic acid and resulting in coagulation of milk protein (Miwada et al, 2006). This milk-clotting of protein in milk suspension has undergone a change from liquid to semi-solid to solid phase. Table 1 shows that the highest viscosity of fermented milk product was in *tali* bamboo tube was higher (P<0.05) and the lowest in *delepung* bamboo. The fermentation treatment of cow milk in *tali* bamboo tubes produce a higher total acidity of the product as well as a lower pH value compared to the other treatments, thus the impact on coagulation of milk protein was more dominant. Based on Surono (2004) and Savadogo et al. (2004) concerning the identification of dominant *Lactobacillus* (LAB) in whey product previously fermented in bamboo tubes may also apply in this study. This was also supported by Chen et al. (2010) that LAB species of *Lactobacillus* (*L. Plantarum*) was predominantly found in *Jiang-sun* products (Taiwan local fermentation product fermented in bamboo). Therefore, the higher quantity of powder in *tali* bamboo tube than the other treatments would help the performance of *Lactobacillus* to accelerate the formation of lactic acid (Prayitno, 2006) resulting in the higher clotting of milk protein reflected in the high viscosity product.

The water content of fermented milk products related to the level of total solidity. Level of product consistency in treatment (T) also proved its significance in terms of chemical indicators of fermented milk, such as water content (Table 1). Fermented milk in *tali* bamboo tube (T) had the lowest water content (P<0.05) compared to the other treatments, although not statistically significantly different from treatment (A). Low water level on treatment (T) proved that it was physically proven in relation to chemical quality. The tendency of a higher total acid (P<0.05) in (T) and lower pH value caused the interaction of water in milk protein component to be low. This low interaction led to the lower moisture content of the product. Haque et al (2010) showed that the interaction of water in the protein components of milk is important factor assumed to induce instability of protein and eventually affect the solubility of dairy products. The percentage of the lowest water level on treatment (T) was the cumulative impact of bacteria performance *tali* bamboo powder, ie starting from low pH value, the acidity and viscosity, were higher and had significant impact on the percentage of product water.

Research results showed that the percentage of fermented cow milk protein in bamboo tubes were not statistically significantly different in percentage. Proteins are known as the important chemical component of milk in dairy fermentation process as the source of nutrients for the LAB to survive (Widodo, 2003). Although the physical appearance and the percentage of water content showed a significantly different result, it was not accompanied by significant changes in the decrease or increase in milk protein percentage. Type of *delepung*, *ampel* and *tali* bamboo with a potential powder suspected of containing LAB had successfully performed its function as a natural incubator in milk fermentation process although the different performance difference in helping the fermentation process was not proven to the point of the protein quality of products (Table 1).

Statistical analysis showed that the fat content of fermented products in various kinds of bamboo was not significantly different. Fats are important components in fresh milk with a composition about 3.13 to 4.71% (Widodo, 2003). The LAB assumed to contain in bamboo powder has not reached the point of milk fat significant biodegradation. Taufik (2004) also mentions that the components of the fat in "dadih" product is the last component of the biodegradation experience by bacteria so that their existence is still maintained unlike other components such as, lactose and protein. It is known that LAB particularly *L. Bulgaricus* is used to ferment lactose milk (Miwada et al., 2006) to produce lactic acid. The ability of *L. Bulgaricus* in producing high lactic acid (Rashid et al., 2007) eventually led to coagulation of the milk proteins. This mechanism proves that the milk fat component has undergone the last past of the degradation process. One particular thing in this study was the percentage of fermented milk fat was quite low, even lower than fresh milk components. This could be due to the fresh milk quality related to the quality of feed given prior to milking the cows.

LAB is a non-pathogenic microbial species found predominantly in fermented milk products. Its existence is high in acid condition and causes bacterial pathogens unable to compete. Proportion or the number of total LAB counted in each treatment was significantly different (P<0.05). The total number of LAB that grew dominantly in fermented milk products in *tali* bamboo in treatments D and A number of LAB was temporarily not significant. It previously has been found from physical observation on treatment T product, showing quality of fermented milk product closest to a standard values. Results obtained in this study supported the evidence reported by Zakaria et al. (1998), although during the fermentation progress of each treatment LAB was not added. The performance of LAB in this study was purely from the incubator of each bamboo. This is in accordance with the opinion Zakaria et al (1998) that there is LAB in bamboo powder and also by Surono (2004) and Savadogo et al. (2004). Tamang et al. (2008) further supported this result with the isolation of both phenotypes and genotypes LAB profiles on various products like *mesu*, *soidon*, *soibum* and *soijim* (local products in India that are fermented in bamboo). It mentioned that the products were dominated by LAB to 108 CFU/g and was identified as the type strain of *Lactobacillus brevis*, *Lb*. *plantarum*, *Lb*. *curvatus*, *Pediococcus pentosaceus*, *Leuconostoc mesenteroides subsp*. *Mesenteroides*, *Leuc*. *Fallax*, *Leuc*. *Lactis*, *Leuc*. *citreum* and *Enterococcus*. The *tali* bamboo that had higher

Table 1. Characteristics of milk fermented in different types of bamboo tube

Variable	The places of fermentation		
	Delepung bamboo (D)	*Ampel* bamboo (A)	*Tali* bamboo (T)
Value of pH	4.97 ^{a}	4.87 ^{ab}	4.82 ^{b}
The amount of acid (%)	0.78 ^{a}	0.80 ^{ab}	0.82 ^{b}
Tickness (min)	0.38 ^{a}	0.53 ^{b}	1.08 ^{c}
Water content (%)	88.70 ^{a}	87.53 ^{b}	87.26^{ab}
Protein content (%)	2.85 ^{a}	2.67 ^{a}	2.88 ^{a}

Values bearing different superscript at the same row differ significantly (P<0.05) quantity of powder than *delepung* and *ampel* bamboo, has shown to function more effectively as a natural incubator for the biodegradation lactose milk. During this function in the process of biodegradation of milk lactose fermentation is always carried out by the LAB deliberately inoculated and its effectiveness isinfluenced by the quality of inoculants or LAB starter used (Miwada et al., 2006).

Conclusions

The evaluation results proved that *tali* bamboo has a potential as a natural incubator better than *delepung* or *ampel* bamboos, in term of physical quantity, water content and the number of LAB that are found in fermented milk products. However the three types of bamboo did not have a significant percentage of protein and fat products.

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