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The Effect of Culture Lactobacillus Plantarum on Characteristics of Buffalo Buttermilk

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Abstract: ***The research was conducted at Agriculture Product Chemistry Laboratory, Faculty of Agriculture, Universitas Sriwijaya, Indralaya, Indonesia. In this research, whey of gathering from the process of separating buffalo from cream milk and whey gathering from churning process of butter. In this research, Lactobacillus plantarum as culture was used with fermentation s combination treatments to make fermented buttermilk. Randomized block factorial design was used. There were three levels of culture concentration, and two levels of fermentation time. The result showed than increased the level of culture concentration will increase total solids, viscosity, and total bacteria, but decrease of pH. Increased the level of fermentation time, tended to increase total solids, viscosity, and total bacteria, but it tended decreased of pH.***

Keywords: Buttermilk, *Lactabacillus plantarum*, whey

1.Introduction

The name "buttermilk" suggests buttery, high - fat milk, but this couldn't be further from the truth. Buttermilk contains no butter, and it's actually lower in fat than regular milk (Warner, 1976). The "butter" in the word buttermilk refers to the origins of this versatile fermented beverage, which resulted from the process of churning butter. Buttermilk adds tangy flavor and creamy richness to dishes from savory to sweet, and powers the leavening in baked goods (AOAC, 2005).

Buttermilk is a by - product obtained from the batting insertion in the process of obtaining cream and butter and it is constituted by fat globules which are surrounded by milk fat globule membranes (MFGMs). During the stirring process, the membrane is ruptured and the various components present therein are released (Metzger, et al, 2000; Murtaza, et al, 2013; Jedidi, et al, 2014). Because it has a high nutritional content and low cost, buttermilk has drawn attention in the prospect of new forms of application. In addition, its disposal is expensive and not biologically viable (Li & Corredig, 2014). The objective of this work is to present a compilation of the technological and biological activities of buttermilk. Among the technological properties, it is worth mentioning its application as in the production of functional foods, a conduit for the incorporation of probiotics, inhibition of bacterial adherence on industrial surfaces, as well as the encapsulation of easily degraded activities and fermentative processes. Among the biological properties, its antioxidant, hypocholesterolemic, antimicrobial, and anticancer activities standout (USDA, 2005). In conclusion, the reuse of buttermilk is economically and sustainably viable and encourages increasing research related to its use.

From the batting inserted in the manufacturing process of the cream of fresh milk and butter, it is possible to obtain a by - product derived from the aqueous phase, called buttermilk (Ortigosa, et al, 2001; Puerto, et al, 2004; Park, et al, 2007). Buttermilk is made up of fat globules which are surrounded by membranes called milk fat globule membranes (MFGMs) (Leroy & Vuyst, 2004; Mastright, et al, 2017). Such membranes avoid its coalescence and its enzymatic degradation. During agitation, the fat globules are disrupted releasing various components dispersed into the aqueous medium such as polar lipids and fragments of MFGMs, which are possessing high functional potential due to their nutritional and technological characteristics (Ong, et al, 2006).

Cultured buttermilk is another type of buttermilk obtained by intentional acidification of skim milk obtained by adding the buttermilk starter cultures (Oberg, 2011; Li, et al, 2012). Cultured buttermilk is manufactured from skim milk fermented by mesophilic lactic (*Lactococcus lactis* subsp. *lactis* and subsp. *cremoris*) and aroma cultures (*Leuconostoc* spp. and L. *lactis*subps. *lactis* biovar. diacetylactis) (Broadbent, et al, 2003; Axelsson, 2004; Kourkoutas et al, 2006). The milk is boiled at 85°C for ~ 30 min to enhance the viscous nature of the product and preventing at the same time, wheying - off and disrupting the undesirable microbes and pathogens if present (Hamzah, 2016a; Hamzah 2016b). After fermentation is complete, the resulting curd is broken down and stirred slowly followed by cooling and salting it slightly.

Materials and Methods

The material used in the experiment gathering from the waste of buffalo milk butter. When the process of separating cream milk, the whey part was gathered and mixed with another whey was gathered when cream milk was churned to became butter (Gardiner, et al, 1998; Buriti, et al, 2007). The culture of *Lactobacillus plantarum* got originally isolated from bekasam traditional local fermentation (Hamzah, 2016; Hamzah, 2016a). The media used in the experiment was MRS. There were three concentrations of culture were prepared, namely 1% (w/w), 2% (w/w), and 3% (w/w).

The experiment used a statistical model, a completely randomized factorial block design with three treatments, concentration of cultures as the first factor. Another factor was fermentation time (hours), namely two hours and four hours. Five replications were applied. In the experiment, chemical analysis performed was moisture content, then to be converted to total solid (%). The other was pH determination was performed on each treatment combinations. The physical analysis, viscosity fermented buttermilk was determined. And the last analysis, was bacterial enumeration was determined.

2.Results and Discussion

Total solid of fermented buttermilk

Culture concentrations had significant effects on total solid. There were significant different among treatments. The treatment of 1% (w/w) of culture had significant different to two other treatments, 2% (w/w) and 3% (w/w). But there was no significant different between treatments of 2% (w/w) and of 3% (see table 1).

Table 1: The Effect of Culture Concentrations on Total Solids

CoC (%, w/w)	TS LSMEANS	p>t comparison of all means 1 2 3		
1	13, 4	- - -	0.0032	0.0045
2	12.6		- - -	0.1465
3	12.2			- - -

C. V. = 1.57
CoC = Concentration of Culture *Lactobacillus plantarum*
TS = Total Solid (%)

When concentration of culture increased, applied, it tended to increase total solid. Fermentation time had significant effects on total solid. There were significant different among treatments. The treatment of two hours had significant different to four hours of treatments (Table 2) The data showed that increased fermentation time tended to increase total solid.

Table 2: The Effect of Fermentation Time on Total Solids

FT (hours)	TS LSMEANS	p>t comparison of all means 1 2	
2	12.4	- - -	0.0014
4	12.1		- - -

C. V. = 1.42
FT = Fermentation Time (hours)
TS = Total Solid (%)

pH of fermented buttermilk

Culture concentrations had significant effects on pH. There were significant different among treatments. The treatment of 1% (w/w) of culture had significant different to two other treatments, 2% (w/w) and 3% (w/w). But there was no significant different between treatments of 2% (w/w) and of 3% (Table 3). When concentration of culture increased, applied, it tended to decreased the pH.

Table 3: The Effect of Culture Concentrations on pH

CoC (%, w/w)	pH LSMEANS	p>t comparison of all means 1 2 3		
1	4.54	- - -	0.0024	0.0036
2	4.12		- - -	0.3762
3	4.15			- - -

C. V. = 1.42
CoC = Concentration of Culture *Lactobacillus plantarum (%, w/w)*

Fermentation time had significant effects on pH. There were significant different among treatments. The treatment of two hours had significant different to four hours of treatments (Table 4). The data showed that increased fermentation time tended to decrease pH.

Table 4: The Effect of Fermentation Time on pH

FT (hours)	pH LSMEANS	p>t comparison of all means 1 2	
2	4.56	- - -	0.0015
4	4.17		- - -

C. V. = 1.82
FT = Fermentation Time (hours)

Culture concentrations had significant effects on viscosity. There were significant different among treatments. The treatment of 1% (w/w) of culture had significant different to two other treatments, 2% (w/w) and 3% (w/w). But there was no significant different between treatments of 2% (w/w) and of 3% (see table 5). When concentration of culture increased, applied, it tended to increase pH.

Table 5: The Effect of Culture Concentrations on Viscosity

CoC (%, w/w)	VISC LSMEANS	p>t comparison of all means 1 2 3		
1	50.32	- - -	0.0086	0.0052
2	55.75		- - -	0.7654
3	58.86			- - -

C. V. = 1.76
CoC = Concentration of Culture *Lactobacillus plantarum (%, w/w)*
VISC = Viscosity (gf)

Fermentation time had significant effects on viscosity. There were significant different among treatments. The treatment of two hours had significant different to four hours of treatments (Table 6). The data showed that increased fermentation time tended to increase viscosity.

Table 6: The Effect of Fermentation Time on Viscosity

FT (hours)	VISC LSMEANS	p>t comparison of all means 1 2	
2	51.54	- - -	0.0087
4	57.19		- - -

C. V. = 1.42
FT = Fermentation Time (hours)
VISC = Viscosity (gf)

Total bacteria of buttermilk

Culture concentrations had significant effects on total bacteria. There were significant different among treatments. The treatment of 1% (w/w) of culture had significant different to two other treatments, 2% (w/w) and 3% (w/w). But there was no significant different between treatments of 2% (w/w) and of 3% (Table 7). When concentration of culture increased, applied, it tended to increase total bacteria.

Table 7: The Effect of Culture Concentrations on Total Bacteria

CoC (%, w/w)	TB LSMEANS	p>t comparison of all means 1 2 3		
1	5.32	- - -	0.0039	0.0067
2	6.69		- - -	0.8645
3	6.76			- - -

C. V. = 1.76
CoC = Concentration of Culture *Lactobacillus plantarum (%, w/w)*
TB = Total bacteria (log cfu per gram)

Fermentation time had significant effects on total bacteria. There were significant different among treatments. The treatment of two hours had significant different to four hours of treatments (Table 8). The data showed that increased fermentation time tended to increase total bacteria.

Table 8: The Effect of Fermentation Time on Total Bacteria

FT (hours)	TB LSMEANS	p>t comparison of all means 1 2	
2	6.34	- - -	0.0031
4	8.12		- - -

C. V. = 1.76
FT = Fermentation Time (hours)
TB = Total bacteria (log cfu per gram)

3.Conclusion

1. Concentration of culture Lactobacillus plantarum had significant effect on total solid, pH, viscosity, and total bacteria of buttermilk.
2. When concentration of culture increased, total solid, viscosity, and total bacteria tended to be increased, but tended to be decreased in pH.
3. Fermentation time applied to buttermilk had significant effect on total solid, pH, viscosity, and total bacteria of buttermilk.

4. When fermentation time increased, total solid,, viscosity, and total bacteria tended to increased, but tended to be decreased the pH.

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Conflict of Interest

The authors have declared no conflict of interest.

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