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WASTE MINIMIZATION OF CHEESE-MAKING BY-PRODUCT DISPOSAL THROUGH ETHANOL FERMENTATION AND THE UTILIZATION OF DISTILLERY WASTES FOR FERTILIZER

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ABSTRACT

Whey as cheese-making by-product has become a threat toward the sustainability of production process at small medium enterprises (SMEs) cheese producer. High organic contents lead high pollution load to the environment, because until now the producer still dispose the waste to the stream or land. Whey utilization through simple ethanol fermentation could reduce high organic content and highly implementable in SMEs level because its easiness. The research aimed to determine waste minimization through ethanol fermentation and the utilization of distillery wastes for fertilizer. Research was done experimentally with substrate variation (whey and napa cabbage) with and without 10% molases addition that fermented by indigenous yeasts consortium (*Candida lambica* and *Prototheca zopfii*) on various temperature (24-27°C and 17-21°C) for 96 hours. The ethanol contents measured by using dichromate oxidation methods. After fermentation finished substrates distilled two stages, the first stage distillery wastes were analyzed for the contents of N (Kjeldahl), P_2O_5 (Bray I) and Potassium (AAS). Results showed that the combination of whey and napa cabbage (1:1) with 10% molasses addition that fermented by *Candida lambica* and *Prototheca zopfii* on 17-21°C resulted in 11.06% of bioethanol contents in 72 hours fermentation. After two stages distillation, 11.2% substrates can converted into ethanol and 37.9% of water resulted from second stage distillation that can disposed to the environment. Meanwhile, 50.9% of first stage distillery wastes has 0.56% N, 0.83% P and 0.35 K which suitable with the Indonesian Agriculture Ministerial Decree No.28/2009 of minimum technical requirement for organic fertilizer. Ethanol fermentation from cheese whey with napa cabbage wastes and 10% molasses addition that fermented by *Candida lambica* and *Prototheca zopfii* consortium and the utilization of its distillery wastes for fertilizer could minimize wastes up to 62.1%.

Keywords: cheese whey, napa cabbage, ethanol, fertilizer, wastes minimization

INTRODUCTION

Cheese making by-products which was known as whey increasingly to the attention of cheese producers especially in Small Medium Enterprises (SMEs) scale. Cheese whey often discharged directly to the environment and supposed to be one of the causes of pollution. Cheese whey has low acidity (pH) so that can cause problems, especially if disposed into stream that have low water discharge. The organic matter left behind on cheese whey was potential to cause eutrophication if discharged directly into water bodies. Meanwhile, organic materials owned allow cheese whey to be processed into commodities.

Organic materials with the largest number owned by cheese whey is lactose. Lactose is a specific carbohydrate owned by dairy products and its content up to 5% [1]. As carbon source for microorganisms, lactose widely used in bioprocess medium for the growth of lactic microorganisms. Lactic microorganisms synthesized lactose into glucose and galactose, then metabolized through the glycolytic pathway to generate energy, organic acids and ethanol [2][3].

Several indigenous yeasts and yeast-like microorganisms have good ability in ethanol fermentation from wastes. *Candida lambica* isolated from mozzarella whey to ferment ethanol up to 0.15% within 48 hours at room temperature and have a sugar content and resistance to high ethanol [4]. *Prototheca zopfii* was yeast-like organism that capable in fermenting ethanol in extreme conditions, this type was found in some milk-based and cellulose-based wastes [5][6].

The addition of sugar complex based substrates such as cellulose is one way that can be done to increase the ethanol contents resulting from cheese whey fermentation. Napa cabbage waste was a potential cellulose-based substrate for ethanol fermentation [7]. The addition of other cellulose-based substrate such as molasses in cheese whey fermentation resulting in 2.06% ethanol with 92.71% sugar conversion [8].

Fermented substrates were purified by