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Quality improvement of fermented wheat pollard with addition of vitamin minerals seen from potential hydrogen content, total lactic acid bacteria and total yeast

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Abstract. The research aim was to examine the quality improvement of fermented wheat pollard with addition of vitamin and minerals. Research material consists of wheat pollard, aquades, fermented cabbage waste, vitamin and minerals. Research method begins with smooth the cabbage waste and added 8% salt and 6,7% molasses from the weight of fresh cabbage, then fermented during 6 days. Fermented cabbage waste was then mixed with wheat pollard which has been preheated at temperature 121°C during 15 minutes and mixed with minerals as much 0; 2,5; 5; 7,5 and 10%, afterwards fermented during 4 days. Research design was with the parameters of potential hydrogen and total lactic acid bacteria using a complete random pattern design with 5 treatments and 3 repetitions, while the parameters total yeast was using descriptive methods. Result of research indicated that potential hydrogen was non significant ($p < 0,05$) in all treatment, total lactic acid bacteria was non significant ($p < 0,05$) in all treatment, while the highest total yeast was with the population 3×10^5 CFU/ml with type of *Saccharomyces cerevisiae*. The conclusion of research was the wheat pollard fermented with addition of vitamin and minerals had no impact on the potential hydrogen aspects and the total lactic acid bacteria produced, but there was a growing yeast.

1. Introduction

Wheat Pollard is the residual result of wheat grinding that potential to be used as feed ingredients for stimulate animal's growth, improve feeds efficiency, and improve animal's health. Wheat Pollard or Wheat Bran has better quality compared with Wheat Lunteh or Bran because it doesn't has any anti-nutrition, low water content, 4% crude fat, and around 15.5% protein [1]. Wheat Pollard's weakness is high crude fiber content, it needs to be processed in order to increase digestibility. One of the ways to improve nutrient's quality, especially the protein and reduce fiber crude for easier to digest is fermentation. Wheat pollard fermented with tempe yeast contains nutrients including 16.98% crude protein, 12.88% crude fiber, 4.0% crude fat [2].

Animal's feed fermentation has three objectives, namely to improve nutritional ingredients, increase feed digestibility value, and preserving feed [3]. Steamed Wheat Pollard can decrease anti-nutrition and increase gelatinization. It can change carbohydrate component in order to digest easily hence the poultry digestive tract can be act as prebiotic [4, 5]. Prebiotics can be a source of energy or limited nutrients for the intestinal mucosa and substrate for the intestinal bacteria fermentation in producing vitamins and antioxidants that can benefit its host [5]. Quality improvement of fermented wheat pollard can be done with addition of vitamin and minerals so that it helps the growth of lactic acid bacteria [6]. The mineral addition is a substance that stimulates growth, the supply of natural



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antibiotics and antioxidants that are useful for poultry. Various types of minerals such as Mn, Mg, Mo, Zn, Ca, Co, Cu, Cl, Fe, K minerals can be used instead of the use of AGP to meet the poultry nutritional needs [7, 8].

Feed additives addition to the ration can increase optimal poultry production [9]. Feed additives that are commonly used as growth boosters are antibiotic growth promotor (AGP) with benefit to increase productivity, reduce bacterial populations in the digestive tract, and reduce mortality [10]. Currently the antibiotics used as a support need has been limited because it can have a negative effect on meat in the form of antibiotic residues. With the negative impact of the use of AGP, the experts gave innovation by using natural ingredients such as the provision of vitamin and minerals, microbial probiotics, prebiotics and synbiotics as a substitute for AGP [9]. One of example of natural AGP is the use of biolacta products, which contain vitamin minerals used as supplements in animal feed, in order to optimize the absorption and metabolic processes of feed ingredients in poultry bodies [11]. Supporting components such as vitamin minerals, prebiotics and coenzymes function to maintain the body's metabolism and maintain the health of the digestive tract for absorption of nutrients [9]. The research aim was to examine the quality improvement of fermented wheat pollard with addition of vitamin and minerals.

2. Materials and Methods

2.1. Materials

The materials used in this research were wheat pollard, aquades, cabbage waste fermented, vitamin mineral consisting of POX [CoSO₄, KAl(SO₄)₂, Na₂SeO₃], Zagromix [H₃BO₃, Na₂MoO₄, vitamin C, vitamin E, vitamin B Complex], Urea, NaCl, MgSO₄, MnSO₄, ZnSO₄, CaCl₂, FeSO₄, CuSO₄, MSG with each level of administration 0, 2.5, 5, 7.5 and 10%. The equipment used were a blender to refine the sample, a filter to filter wheat pollard, trays and stirrers for mixing samples with vitamin and minerals, digital scales for weighing samples, plastic for fermentation, autoclaves for sample sterilizers, pH meters for measuring pH sample, straining fabric for the tray cover when the sample was dried in the sun.

2.2. Methods

The research method was carried out in 2 stages, namely: 1) Making cabbage waste fermentation according to [12] and [13]; 2) Processing of wheat pollard and addition of mineral vitamins.

2.2.2. Making cabbage waste fermentation. The making of cabbage waste fermented began by smoothing the cabbage waste using a blender, adding 8% salt and 6.7% molasses from the fresh weight of cabbage waste, then put in the silo and fermented for 6 days in a facultative anaerobic state.

2.2.3. Processing wheat pollard and adding vitamin and minerals. The processing of wheat pollard began by mixing wheat pollard with aquades then stirring it until it is homogeneous, then autoclaved at 121°C for 15 minutes. Then the wheat pollard was removed from the autoclave and aerated. Furthermore, wheat pollard was mixed with vitamin and minerals as well as cabbage waste fermented until all three were homogeneous. The samples were facultatively anaerobic fermented for 4 days, then it was dried and was mashed.

2.2.4. pH Test. Samples that have been given treatment were tested using a pH meter.

2.2.5. Total Lactid Acid Bacteria Test. Laboratory tests carried out include analysis of total lactic acid bacteria conducted in the microbiology laboratory. Total lactid acid bacteria was determined using the Total Plate Count (TPC) using de Man Rogosa and Sharpe (MRS) growing media [14].

2.2.6. *Total Yeast Test.* Laboratory tests were carried out include analysis of total yeast carried out in the microbiology laboratory. Total yeast was determined using the method of Total Plate Count (TPC) which was a method of determining the number of microorganisms as a whole both molds, yeasts and bacteria in a material using Sabouroud Glucosa Agar (SGA) growing media [15].

2.3. *Data Analy*

The study used a Completely Randomized Design (CRD) of unidirectional pattern with 5 treatments and 3 repetitions, namely:

- T0 = processed wheat pollard + 0% vitamin minerals
- T1 = processed wheat pollard + 2.5% vitamin minerals
- T2 = processed wheat pollard + 5% vitamin minerals
- T3 = processed wheat pollard + 7.5% vitamin minerals
- T4 = processed wheat pollard + 10% vitamin minerals

The parameters observed were the potential hydrogen value (pH), total lactic acid bacteria and total yeast. Data on the potential hydrogen value (pH) and total lactic acid bacteria obtained were processed by various analyzes to determine the effect of the treatment on the measured variables. If there is a significant relationship the the analysis was continued with Duncan's multiple range test [16]. While the total yeast data was presented in a descriptive quantitative manner.

3. Results and Discussion

The effect of the treatment of vitamin minerals addition to the potential hydrogen value (pH) is presented in Table 1, the total lactic acid bacteria are presented in Table 2 and the total yeast is presented in Table 3.

3.1 Potential Hydrogen (pH)

Table 1. Average results of the vitamin minerals addition to the potential hydrogen value.

Treatments	Addition (%)	Repetition			Average pH
		1	2	3	
T0	0	4.15	4.11	4.09	4.11 ± 0,03
T1	2.5	4.09	4.16	4.06	4.10 ± 0,05
T2	5	4.20	3.93	4.16	4.09 ± 0,14
T3	7.5	4.04	3.96	4.02	4.00 ± 0,04
T4	10	4.02	4.06	4.09	4.05 ± 0,03

The result of variance analysis showed that wheat pollard fermented with vitamin minerals addition had no significant effect ($P > 0.05$) on the potential hydrogen value (Table 1). This was due to the fact that vitamin minerals addition makes the potential hydrogen condition of wheat pollard become acidic, so that there was increasing the lactid acid bacteria growth. Quality improvement of wheat pollard fermented can be done by adding vitamin A, vitamin B complex and vitamin C and minerals Mn, Mg, Mo, Zn, Ca, Co, Cu, Cl, Fe, K. It helped the growth of lactic acid bacteria [6, 8]. Lactid acid bacteria require suitable environmental conditions including temperature, potential hydrogen (pH) and nutrient content [17]. Lactic acid bacteria can live at a low potential hydrogen of 2 - 6.5 [18]. Decreasing the potential hydrogen around 4-5 can inhibit the growth of other microorganisms, especially pathogenic bacteria [10]. The greater the content of lactic acid produced during the wheat pollard fermentation process then the potential hydrogen gets lower and the shelf life of feed becomes long [6]. The lack of growth factors such as vitamin and minerals elements caused the rate of growth of lactic acid bacteria to eventually decrease in the stationary phase [19]. The more lactic acid was produced then the potential hydrogen would be more acidic [6].

3.2 Total Lactid Acid Bacteria

Table 2. Average results of the vitamin minerals addition to the total lactic acid bacteria.

Treatments	Addition (%)	Repetitions			Average LAB (10 ⁴ CFU/ml)
		1	2	3	
T0	0	10.02	9.76	9.90	9.89 ± 0.12
T1	2.5	9.35	9.40	9.89	9.55 ± 0.29
T2	5	9.23	9.75	9.89	9.62 ± 0.34
T3	7.5	9.47	9.16	9.89	9.51 ± 0.36
T4	10	0	8.98	9.23	6.07 ± 5.26

The results of variance analysis showed that vitamin minerals addition to wheat pollard fermented had no significant effect ($P > 0.05$) on total lactic acid bacteria. (Table 2). Lactid acid bacteria are a species of bacteria with the ability to form lactic acid from carbohydrate metabolism result and grows at low potential hydrogen [17]. These results indicated that vitamin minerals addition did not significantly change the potential hydrogen value and the total lactid acid bacteria of wheat pollard fermented. This was due to the different bacterial growth rates, environmental conditions for living, and potential hydrogen values. Quality improvement of wheat pollard fermented can be done by adding vitamin A, vitamin B complex and vitamin C and minerals Mn, Mg, Mo, Zn, Ca, Co, Cu, Cl, Fe, K so that it helped the growth of lactic acid bacteria [6, 8]. Arabinosa, raffinosa, manosa and oligosaccharides had function as prebiotics and a source of nutrition for lactid acid bacteria [5]. Lactid acid bacteria required suitable environmental conditions including temperature, potential hydrogen (pH) and nutrient content [17]. Vitamins needed for lactid acid bacteria growth included vitamin A, vitamin B complex and vitamin C, while the minerals needed were minerals Mn, Mg, Mo, Zn, Ca, Co, Cu, Cl, Fe, K [7, 8].

3.3 Total Yeast

Table 3. Result of vitamin minerals addition to total yeast.

Treatment	Addition (%)	Repetitions			Total Yeast (10 ⁵ CFU/ml)
		1	2	3	
T0	0	0	0	3	1
T1	2.5	0	0	1	0,33
T2	5	0	0	0	0
T3	7.5	0	0	0	0
T4	10	0	0	0	0

The results showed the highest total yeast were in the treatment without the vitamin minerals addition (T0). It was the population 1×10^5 CFU/ml with the type of *Saccharomyces cerevisiae* (Table 3). These results indicated that the vitamin minerals addition did not significantly change the total yeast of wheat pollard fermented. This was because the manufacture of wheat pollard fermentation used as a starter of agricultural waste. Cabbage was containing probiotics, hence the growth of yeast was very possible. Pollard smothered by vegetable waste fermentation for 4 days into pollard with probiotic had a total fungi consisting of yeast *Saccharomyces cerevisiae* and mold of *Rhizopus sp.* as much as 13×10^3 CFU/g [17]. Yeast growth was influenced by factors of temperature, potential hydrogen and the same water content, nutrients availability, oxygen availability. The several factors that affected the yeast growth were including potential hydrogen, aw, oxygen availability and anti-fungal substances [20]. Most microorganisms growth well at pH 7 while at pH <3.7. It can grow only lactic acid bacteria, mold and yeast [21]. The potential hydrogen range was in the comfort zone of the fungi to grow and develop, so that causes a lot of total yeast to grow.

4. Conclusion

Based on the results of the study, the wheat pollard fermented with addition of vitamin minerals had no impact on the potential hydrogen aspects and the total lactic acid bacteria produced, however, the yeast would growth faster.

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