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The effect of adding probiotic *Saccharomyces cerevisiae* on dietary antibiotic-free on production performance and intestinal lactic acid bacteria growth of broiler chicken

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Abstract. This study aims to determine the effectiveness of using yeast named *Saccharomyces cerevisiae* as a probiotic in the maintenance of broiler chickens that are free from antibiotic administration and to obtain the most efficient dose of *Saccharomyces cerevisiae* as a feed additive. The success of this study supports the government's program for the future that will prohibit antibiotics usage in poultry feed, especially broiler chickens. This study consisted of 5 treatments and 5 replications for each treatment. Each replication consisted of 10 heads of broiler chicken aged 14 days. Treatment I = formulation feed (control) without yeast addition (P0), treatment II = control plus yeast 0.5 g/kg of feed (0.05%) (P1), treatment III = control plus 1 g/kg of feed (0.1%) (P2), treatment IV = control plus yeast 1.5 g/kg of feed (0.15%) (P3), and treatment V = BR1 commercial feed (K). Observations were carried out since the chickens aged 14 days to harvested on aged 35 days. Data were analysed using one way analysis of completely randomized design (CRD) by IBM SPSS Statistics 23. Significantly different results were followed by Duncan's new multiple range test (DMRT) to determine differences between treatments. The results of this study indicate that the addition of *S. cerevisiae* up to 1.5 g/kg of feed (0.15%) on dietary free-antibiotics did not affect production performance (P1, P2, P3) compared to control (P0), however still lower than broilers fed BR1 commercial feed (K). Addition of *S. cerevisiae* as probiotic on dietary free-antibiotic had a greater role for improving health status by 0% mortality and tends to increase lactic acid bacteria in the duodenum intestinal tract.

1. Introduction

Chicken is a potential commodity that has economic value as the most popular source of animal protein that is quite cheap and affordable for society. Chicken consumers recently begin to avoid broiler chicken meat due to concerns about antibiotic residues. It was derived from chicken feed which used as growth promotor or medicine for preventing or treating broiler chicken health. This inspires nutritionist to provide quality rations and produce the product of broiler chicken meat that are free antibiotic by using probiotic as feed additive.

Probiotic is microbes or spores that live or develop in the intestine and be able to benefit their hosts from their metabolites directly or indirectly [1]. The characteristics of probiotic has not pathogenic and safe product when consumed [2], and improve the balance of intestinal microflora when entering the digestive tract [3]. The most probiotic that attracted the attention are the local yeast product named



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Saccharomyces cerevisiae (*S. cerevisiae*). *S. cerevisiae* is safe and widely applied to the feed sector, especially in feed fermentation [4]. *S. cerevisiae* is used to improve animal health as a probiotic and immunostimulant which is administration of feed additives [5]. *S. cerevisiae* has the potential as a probiotic agent to replace the function of antibiotics as growth stimulants. The results of previous studies indicated that the use of *S. cerevisiae* culture can increase the amount of lactic acid bacteria (BAL) which will make the digestive tract environment become acidic, so that pathogenic bacteria cannot tolerate the acidic environment and cannot develop well. The success of this research strongly supports the government's program for the future which will prohibit the antibiotics usage in poultry feed, especially broiler chickens.

2. Methodology

The study was held in UPT Agricultural Production and the analysis was carried out at Feed Technology Laboratory, State Polytechnic of Jember. This study used 250 Day Old Chick broiler chickens. The local yeast was *Saccharomyces cerevisiae* of the Optimet @ Sc product which was a screening result from the previous study (a concentration of 10^9 CF/g). Dietary antibiotic-free contained crude protein (CP) 21% and metabolic energy (ME) 3020 kcal/kg, while for BR1 commercial feed contained CP= 20% and ME = 3100 Kcal/kg. This study consisted of 5 treatments and 5 replications for each treatment. Each replication consisted of 10 heads of broiler chicken aged 14 days. .

Treatment I = formulation feed (control) without yeast addition (P0), treatment II = control plus yeast 0.5 g/kg of feed (0.05%) (P1), treatment III = control plus 1 g/kg of feed (0.1%) (P2), treatment IV = control plus yeast 1.5 g/kg of feed (0.15%) (P3), and treatment V = BR1 commercial feed (K). Observations were carried out since the chickens aged 14 days to harvested on aged 35 days. Data were analysed using one way analysis of completely randomized design (CRD) by IBM SPSS Statistics 23. Significantly different results were followed by Duncan's new multiple range test (DMRT) to determine differences between treatments. Parameters observed were feed consumption, body weight gain, feed conversion ratio (FCR), amount of intestinal lactic acid bacteria (LAB) and *Escherichia coli* (*E. coli*).

3. Results and discussion

The addition of probiotic *Saccharomyces cerevisiae* (*S. cerevisiae*) in feed did not give a significant effect for feed intake on P0 to P3. Feed intake of broiler chicken is shown at **Table 1**. This condition was caused the nutritional content sufficiently balanced for all formulation feed containing probiotic, and contained completely of nutritional requirement for broiler chicken. Energy content affects the level of consumption, broiler will stop eating when the energy content is required [6]. Formulation feed of P0 to P3 contained ME 3020 kcal/kg. Energy requirements for broiler finisher period is 2900 - 3200 kcal/kg [7].

Table 1. Feed intake of broiler chicken fed dietary antibiotic-free with and without the addition of *S. cerevisiae*

Weeks	Unit	P0	P1	P2	P3	K
3	g/head/d	70.31 ^a	69.44 ^a	71.86 ^a	72.60 ^a	81.80 ^b
4	g/head/d	104.90 ^a	103.02 ^a	105.96 ^a	108.48 ^a	123.01 ^b
5	g/head/d	132.07 ^a	128.88 ^a	131.19 ^a	139.08 ^a	158.42 ^b
3-5	g/head/d	102.42 ^a	100.45 ^a	103.00 ^a	106.72 ^a	121.08 ^b

^{abc} different superscript at the same row indicated significant differences ($p < 0.05$)

P0 = formulation feed (control) without yeast addition, P1= control with yeast 0.5 g/kg of feed (0.05%), P2= control with yeast 1 g/kg of feed (0.1%), P3 = control with yeast 1.5 g/kg of feed (0.15%), and K = BR1 commercial feed.

Broiler chicken that were given commercial feed (K) had the highest level of consumption compared to the formulation feed (P0 to P3). There was possible form of feed produced from factory products was better than the formulation feed. Broiler chicken preferred granular feed rather than mass. Forms of formulation feed that were more destroyed easily than commercial feed granules. The results of previous studies showed that broilers fed with good quality pellet (88% pellet durability index) produced more consumption than low quality pellet (66% pellet durability index), thus the form of feed would produce lower production performance [6].

The effect of addition of yeast probiotic as an antibiotic substitute up to 1.5 g/kg of feed (0.15%) for 35 days of maintenance did not show an adverse effect on the weight gain. Weight gain of broiler chicken is shown at **Table 2**.

Table 2. Weight gain (WG) of broiler chickens fed with the addition of *S. cerevisiae* yeast

Weeks	Unit	P0	P1	P2	P3	K
2-3	g/head/d	227.23 ^a	216.18 ^a	234.25 ^a	243.99 ^a	361.72 ^b
3-4	g/head/d	358.61 ^a	344.12 ^a	335.24 ^a	359.75 ^a	440.09 ^b
4-5	g/head/d	441.85 ^a	417.35 ^a	418.97 ^a	449.6 ^a	631.36 ^b
3-5	g/head/d	1027.69 ^a	977.65 ^a	988.46 ^a	1053.34 ^a	1433.17 ^b

^{abc} different superscript at the same row indicated significant differences ($p < 0.05$)

P0 = formulation feed (control) without yeast addition, P1= control with yeast 0.5 g/kg of feed (0.05%), P2= control with yeast 1 g/kg of feed (0.1%), P3 = control with yeast 1.5 g/kg of feed (0.15%), and K = BR1 commercial feed.

According to Mountzouris et al [8] that no effect of yeast administration on broiler chickens until the age of 35 days in unhealthy conditions, showed that it was necessary to increase yeast doses and longer maintenance periods from 35 days to 42 days. Shankar [9] also reported that yeast probiotic supplementation given up to 0.2% did not affect the performance of broiler chickens maintained for 42 days. It shows that the role of *S. cerevisiae* as probiotics and for antibiotic replacement is towards prefer as an improving health status to a growth promotor. Probiotic is a biological product which stimulate the immune system and increase its defense activity against pathogenic bacteria [10]. Mannanoglycosaccharides (MOS) and 1,3/1,6 β -glucan are components of the yeast cell wall that act as immunostimulants [11], namely to increase the ability of T cells, B cells and macrophages to fight disease infections, as well as help repair damaged tissue in the body through a process of regeneration and recovery [12].

The addition of yeast probiotics in formulation feed on 0.05%, 0.1%, and 0.15% of dietary antibiotic-free (P1, P2, and P3) did not show a significant effect on feed efficiency as FCR value. The feed conversion ratio (FCR) of chicken broilers is shown at **Table 3**.

Table 3. Feed conversion ratio (FCR) of broiler chickens fed with the addition of *S. cerevisiae* yeast

Weeks	Unit	P0	P1	P2	P3	K
3	head/d	2.17 ^b	2.29 ^b	2.19 ^b	2.10 ^b	1.61 ^a
4	head/d	2.05 ^{ab}	2.1 ^{bc}	2.22 ^c	2.12 ^{bc}	1.96 ^a
5	head/d	2.10 ^b	2.18 ^b	2.23 ^b	2.18 ^b	1.76 ^a
3-5	head/d	2.09 ^b	2.17 ^b	2.20 ^b	2.14 ^b	1.78 ^a

^{abc} different superscript at the same row indicated significant differences ($p < 0.05$)

P0 = formulation feed (control) without yeast addition, P1= control with yeast 0.5 g/kg of feed (0.05%), P2= control with yeast 1 g/kg of feed (0.1%), P3 = control with yeast 1.5 g/kg of feed (0.15%), and K = BR1 commercial feed.

The results showed a tendency for an increase in the number of intestinal lactic acid bacteria (LAB) by the addition of yeast as an feed additive of dietary antibiotic-free especially for P1 and P2, although not significantly different between treatments. The number of *E. coli* in the intestines was markedly decreased, as well as BR1 commercial feed. It is shown at **Table 4**.

Table 4 Amount of intestinal lactic acid bacteria (LAB) and intestinal *E. coli* of broiler chickens fed with the addition of *S. cerevisiae* yeast

Parameter	Unit	P0	P1	P2	P3	K
LAB	CFU/ml	$(8.37 \times 10^7)^a$	$(4.15 \times 10^8)^a$	$(1.79 \times 10^9)^a$	$(9.97 \times 10^7)^a$	$(6.22 \times 10^8)^a$
<i>E. coli</i>	CFU/ml	$(3.89 \times 10^6)^b$	$(7.77 \times 10^5)^a$	$(4.04 \times 10^6)^b$	$(1.03 \times 10^6)^a$	$(4.77 \times 10^5)^a$

^{abc} different superscript at the same row indicated significant differences ($p < 0.05$)

P0 = formulation feed (control) without yeast addition, P1= control with yeast 0.5 g/kg of feed (0.05%), P2= control with yeast 1 g/kg of feed (0.1%), P3 = control with yeast 1.5 g/kg of feed (0.15%), and K = BR1 commercial feed.

S. cerevisiae was useful as a role for improving animal health as a probiotic and immunostimulant. *S. cerevisiae* as a probiotic was not killing microbes even increasing the number of beneficial microbes, in contrast to antibiotics which killed microbes both of harmful or beneficial for the body and showed resistance effect [12]. It was supported by 0% chicken mortality, even the broiler chicken fed dietary antibiotic-free and without any medicines usage during maintenance.

The addition of *S. cerevisiae* could significantly reduce the amount of *E. coli* in the duodenum, especially at doses of 0.05% and 0.15%. The development of LAB causes the condition of the digestive tract became acid that was not suitable for the growth of *E. coli*. In normal conditions, both microorganisms (pathogens and non-pathogens) are in balanced state. There are a number of interactions in the form of symbiosis and attachment between both of them. The balance of the intestinal microflora will be achieved when beneficial microbes can suppress harmful microbes by pushing out the pathogenic microbes from the digestive tract [13].

4. Conclusions and recommendations

Conclusions

Yeast administration of *S. cerevisiae* as a probiotic up to doses of 1.5 g/kg of feed (0.15%) in broiler chickens maintained without using antibiotics did not affect production performance compared to those without yeast. The maintenance of broiler chickens fed antibiotic-free with the addition of *S. cerevisiae* had a greater role for improving health status by 0% mortality and tends to increase lactic acid bacteria in the digestive tract.

Recommendations

The lack of a significant improvement between the yeast addition treatment and under no antibiotics condition, can imply that higher yeast inclusion levels up to 2% and longer experimental durations (i.e., 42 d instead 35 d) should be considered in the future studies. The consideration broiler chicken aged over 35 days are susceptible to disease.

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