RJOAS: Russian Journal of Agricultural and Socio-Economic Sciences
ISSN 2226-1184 (Online) | Issue 2(134), February 2023

UDC 636; DOI 10.18551/rjoas.2023-02.20

THE EFFECT OF ENCAPSULATED LACTOBACILLUS SALIVARIUS PROBIOTIC ON PROTEIN EFFICIENCY RATIO AND CHEMICAL QUALITY OF RABBIT MEAT

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ABSTRACT

The study aimed to analyze the use of encapsulated probiotic Lactobacillus salivarius in complete feed on Protein Efficiency Ratio (PER), meat fat content, meat cholesterol content and income over feed cost (IOFC) of local Rabbit. Thirty-two local male rabbits aged 8 to 12 weeks were taken as the sample of the study. Distribute into five group with four treatments consist of two rabbits in each group. Moreover, the randomized block design (RBD) was geared under the analysis of variance (ANOVA) toward analyzing the experiment. The treatments were TO = control, T1= administration of 0.3 % encapsulated probiotic, T1= administration of 0.5 % encapsulated probiotic. T1= administration of 0.7 % encapsulated probiotic. The result revealed that the administration of probiotic significantly (P<0.05) increases PER and IOFC but reduce the fat content. In addition, the administration of probiotic significantly (P<0.01) increases rabbit meat cholesterol. The provision of probiotics did not considerably affect the cost of feed during the study and the consumption of crude protein, inexorably, the best level of probiotic Lactobacillus salivarius in additives feed was 0.5%.

KEY WORDS

Lactobacillus salivarius, encapsulated probiotic, rabbit meat, cholesterol levels, fat content.

Lately, food safety is mutating into a thorny because residual effect on antibiotic growth promoters in livestock products seriously affects human health as consumers. The use of antibiotics in the feed also causes resistance in animals. Landers et al (2012) argued that 63-65% of antibiotics in livestock's meat and liver contaminated with penicillin and tetracycline antibiotics might cause residues of antibiotic growth promoters. Thus, the Indonesian government regulated 14/PERMENTAN/PK.350/5/2017 as the basis for prohibiting antibiotics as feed additives (Directorate General of PKH, 2017).

Infusing more probiotics is among the effort to displace antibiotics as growth promoters. Probiotics are single strain cultures or a mixture of several live microbial strains that play a role in balancing the microflora in the digestive tract (Imran 2016). Probiotics may increase enzymatic activity in poultry's digestive tract, control cholesterol levels in the blood, and leave inoffensive residues in food (Sjofjan, 2010).

Nowadays, Lactobacillus salivarius endogenous probiotics and Lactobacillus fermentum products from quails' intestines are easy to get (Kalsum *et al.*, 2012[a] ; Kalsum *et al.*, 2012[b]). These probiotics can be used as rabbit additive feed. However, encapsulation technology is required to protect the rabbit's mouth and gizzard areas. Spray drying at 140 – 180^{o} C is the typical technique for encapsulation, and endogenous probiotics are ironically not resistant to high temperatures. Therefore, this study implemented a low temperature of 50^{o} C using a modified oven. Finally, further inquiries on micronutrients and macronutrients to improve the quality of encapsulated probiotic products are necessary.

The development of endogenous probiotics isolated from the digestive tract may affect enzyme activity in the small intestine, inhibit the growth of pathogenic bacteria, prevent their colonization in the small intestine wall, and reduce cholesterol levels without the risk of side effects on livestock and consumers. Infusing more micronutrients and macronutrients through the encapsulation process is expected to improve the probiotics' quantity, quality, and shelf life of the endogenous plus probiotic microbes.

Besides, the encapsulated probiotics were analyzed for their enzymatic abilities. They were tested for their resistance to bile salts, pH of the digestive tract, and pathogenic microbes. Thus, live probiotics were obtained when they arrived in the livestock intestines. Furthermore, the probiotics were biologically examined on the rabbits. Then, a complete analysis of the endogenous plus probiotic encapsulated product was obtained. This probiotic was expected to replace the role of antibiotics so that probiotics would be safe, healthy, intact, and halal obtained. Therefore, improving the quality of encapsulated probiotics is prominent to be evaluated on rabbits. Ultimately, the purpose of this study was to evaluate the use of probiotics on the chemical quality of meat, protein efficiency ratio, and Income over feed cost in rabbits.

MATERIALS AND METHODS OF RESEARCH

Thirty-two local weaned male rabbits aged 8 to 12 weeks were taken as the sample of the study. This study was conducted at the Teaching Farm of University of Islam Malang, East Java. The cages were Individual iron battery cages.

The rabbits were fed by iso nutrient during the study ad libitum. Their drinks were also provided ad libitum. Feeding is done 3 times a day. Moreover, the feed was based on the Indonesian safety standard (SNI). The feed formulation and nutrient content data are presented in table 1.

Table 1 – Feed formulation and nutrient content of research ration

Feed ingredient	TO	T1	T2	T3
Pollard	34	34	34	34
Forage	25	25	25	25
Corn	20	20	20	20
Soybean	17	17	17	17
Premix	2	2	2	2
Tapioca Flour	2	2	2	2
Total	100	100	100	100
Probiotic	0	0.3	0.5	0.7
Nutrient				
Dry Matter	2279	2279	2279	2279
Energy Metabolism	87	87	87	87
Crude Protein	17	17	17	17
Ether Extract	3	3	3	3
Crude Fiber	14	14	14	14
Calcium	1	1	1	1
Phosphor	1	1	1	1

Source: Primary data processed (2022).

The study was initiated by keeping rabbits for 30 days. On the final day of the study, a rabbit was taken to observe its meat chemical composition. The rabbit's chest meat was observed. Protein efficiency ratio and income over feed cost were calculated based on rabbit performance during petting periods with the following formula:

Protein efficiency ratio: Body weight gain /(feed consumption x feed protein) x 100%

Where: IOFC is Income – feed cost; Feed cost is Consumption x feed price.

The sample of the study distributed into five group with four treatments consisting of two rabbits in each group. The randomized block design (RBD) was geared under the analysis of variance (ANOVA) toward analyzing the experiment moreover, the grouping process was based on the rabbits’ body weight. Further research on Duncan analysis would be done if the research did not match with the reliability. In addition, the formula is described as follows:

$$Y_{ij} = \mu + A_i + K_j + \epsilon_{ij}$$

Where: Yij = The value of observations on the treatment of probiotics Salivarius on group i and j; μ = Average; Ai = The effect of Salivarius Probiotic Treatment on group I; Kj = The effect of group weight on group j; ϵij = The effect of error in the treatment of probiotics Salivarius on group i and j.

The four treatments were T0: without administering encapsulated probiotics, T1: administration of 0.3% encapsulated probiotic; T2: administration of 0.5% encapsulated probiotic, T3: administration of 0.7% encapsulated probiotics. The parameters measured in this study were the chemical composition of meat in the form of meat fat and cholesterol, protein efficiency ratio and Income over feed cost.

RESULTS AND DISCUSSIONS

Giving probiotic Lactobacillus salivarius did not significantly affect the consumption of feed protein. The administration of probiotic salivarius significantly ($P<0.05$) increased the protein efficiency ratio (PER). The group had no significant effect on the protein efficiency ratio value. Likewise, the best treatments were treatment T2 (administration of probiotic Lactobacillus salivarius 0.5%) and T3 (administration of probiotic Lactobacillus salivarius 0.7%). The data on protein consumption and PER of local male rabbits aged 8 to 12 weeks are presented in table 2.

Table 2 – Protein consumption and protein efficiency ratio of local male rabbits aged 8-12 weeks

n/n	T0	T1	T2	T3
Protein Consumption	594.00 ± 59.40	600.00 ± 8.49	561.00 ± 69.71	592.50 ± 72.56
PER	1.30 ± 0.12^{a}	1.44 ± 0.02^{ab}	1.70 ± 0.26^{b}	1.67 ± 0.15^{b}

Note: Different superscripts showed a significant difference ($P<0.05$).

Administering probiotics did not significantly affect feed protein consumption because the nutrient content and feed form were identical. Protein consumption was closely related to feeding consumption. In this study, rabbit feed consumption was not significantly different because the feed given had the same nutrient content. Likewise, the probiotics provision was only used as a feed additive in small amounts. The influencing factors of feed consumption included the feed's form, nutrient content, and palatability. In addition, the environment of feed maintenance determined the feed consumption. Rabbits reduced their feed consumption under heat stress. In contrast, versa when the temperature was cold, rabbits increased their feed consumption to warm their bodies (Gidenne et al, 2017).

The probiotics protein efficiency ratio of rabbits at 0.5 and 0.7% levels increased significantly ($P<0.05$) because the growth of rabbits with probiotics treatments was better than rabbits without probiotics treatments. However, the protein consumption was not significantly different (as shown in table 2). Probiotics are live microbes given to livestock. They grow in the digestive tract of livestock to help the digestive process by suppressing the growth of pathogenic microbes that inhibit the process of digestion and absorption. In addition, lactobacillus probiotics are known to produce protease enzymes that help the process of protein digestion. Digestion and absorption of nutrients became more effective so that the rabbit's body weight growth was improving, and the efficiency of protein absorption was increasing (Yi et al, 2020).

The provision of probiotics significantly ($P<0.01$) increased the acceptance of the rabbit farming business but had no significant effect on feed costs during maintenance. The income over feed cost (IOFC) of rabbit culture significantly ($P<0.05$) increased with the administration of the probiotic Lactobacillus salivarius. The group had no significant effect on rabbit IOFC. Moreover, the data on the feed cost during rearing, Reception, and IOFC of local male rabbits aged 8-12 weeks are presented in Table 3.

Implementing probiotics increased livestock acceptance due to a significant increase in rabbit body weight because probiotics produced protease enzymes that increased protein digestibility and absorption. Protein is one type of nutrient that serves to help the process of tissue growth. The increase in rabbit growth might increase the sales of rabbit meat. The greater the rabbit's body weight, the greater the income obtained.

Table 3 – Feed costs during rearing, acceptance and IOFC of male local rabbits aged 8-12 weeks

n/n	T0	T1	T2	T3
Feed Cost	29700.00 ± 2969.85	30750.00 ± 434.87	29218.75 ± 3630.92	31353.15 ± 3839.65
Reception	34320.00 ± 1312.65[A]	38805.00 ± 275.77[A]	42311.25 ± 1973.98[B]	44156.25 ± 1241.31[B]
IOFC	4620.00 ± 2798.94[a]	8055.00 ± 505.90[ab]	13092.50 ± 4807.60[b]	13092.50 ± 4807.60[b]

Note: Different superscripts showed a significant difference.

The higher the farmers' acceptance, the higher the IOFC value increased. The IOFC value described the efficiency of feed costs during rearing. Probiotics infusion could increase the IOFC of rabbits because rabbits consumed the same amount of feed as the control treatment but produced more incredible growth or increased body weight compared to the control treatment. The efficiency of the use of feed occurred because the provision of probiotics reduced the number of pathogenic microbes in the digestive tract of rabbits. After all, probiotics could produce organic acids that could eradicate most of the pathogenic microbes. Pathogenic microbes in the gastrointestinal tract could inhibit digestion and absorption of nutrients (Markowiak and Śliżewska, 2017). In addition, the nutrients could not be fully utilized because these nutrients were used to feed these pathogenic microbes. If the population of lactic acid bacteria (probiotics) increased, the growth of pathogenic microbes would be hampered because many pathogenic microbes could not tolerate acidic environments such as lactic acid bacteria (Markowiak and Śliżewska 2017). Lactobacillus salivarius is one type of microbe belonging to the type of lactic acid bacteria.

Implementing probiotics significantly (P<0.01) reduced rabbit meat's fat and cholesterol levels. The grouping had no significant effect on the cholesterol and fat of rabbit meat. The data on the cholesterol and fat levels of male rabbit meat aged 8-12 weeks are presented in Table 4.

Table 4 – Cholesterol levels and fat content of male rabbit meat aged 8-12 weeks

n/n	T0	T1	T2	T3
Cholesterol	53.12 ± 1.12[C]	48.67 ± 0.75[B]	47.30 ± 3.19[B]	40.35± 2.90[A]
Fat Content	0.48 ± 0.01[A]	0.57 ± 0.13[A]	0.30 ± 0.05[B]	0.17 ± 0.04[C]

Note: Different superscripts showed a significant difference (P<0.01).

Cholesterol and fat content in rabbit meat significantly (P<0.01) decreased due to the treatment of encapsulated probiotic Lactobacillus salivarius. Giving probiotics reduced cholesterol and meat fat levels because probiotics produced organic acids that made the rabbit's digestive tract atmosphere acidic. The rabbit's body might produce a homeostatic process by making the acid in the digestive tract normal by removing bile salts. The use of bile salts for a long time to neutralize the acidic atmosphere in the digestive tract caused the process of cholesterol formation to be hampered because bile salts are one of the raw materials for cholesterol formation. The use of probiotics produced 3-hydroxy-3-methyl-glutaryl-CoA reductase (HMG-CoA reductase) inhibitors. (Abu-Elheiga 1997) Those were enzymes inhibiting cholesterol biosynthesis, lowering blood LDL and VLDL, and triglyceride levels in the blood. The enzymes decreased the activity of acetyl CoA carboxylase, an enzyme that plays a role in the rate of fatty acid synthesis and production of short-chain fatty acids (SCFA) (Cavallini et al, 2009) The decreased absorption and metabolism of cholesterol might inhibit the process of cholesterol biosynthesis in rabbit meat. Consequently, the fat and cholesterol levels in rabbit meat decreased.

CONCLUSION

Ultimately, administering encapsulated probiotic Lactobacillus salivarius feed in the male rabbits aged 8-12 weeks increased the value of protein efficiency ratio, income over feed cost, and reduced fat and cholesterol levels. The best probiotic treatment of Lactobacillus salivarius in rabbit feed aged 8-12 weeks was 0.7%.

ACKNOWLEDGMENTS

This research has been funded by the Ministry of Education Culture Research and Technology in the program University Superior Applied Research 2022. The author thanks a lot for the full support from the Ministry of Education Culture Research and the University of Islam Malang, East Java, Indonesia

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