INFLUENCE OF INDIGENOUS MICRO-ORGANISM (IMO) IN DIET ON FEED ULTIIZATION BY RABBITS

[1*]OYINBO E. O., [1]AGBO. C., [1]SHAAHU D. T., AND [2]TULEUN C. D.

[1]Department of Animal Production College of Animal Science (Joseph Sarwuan Tarka University, Makurdi)
[2]Department of Animal Nutrition College of Animal Science (Joseph Sarwuan Tarka University, Makurdi)

***Corresponding author**: oyinboemmanueloluwasina@gmail.com

Abstract

This study utilized thirty mixed-breed rabbits of both sexes to investigate the effects of indigenous microorganism bacterial (IMO) as a feed additive on the performance of growing rabbits. The study assessed nutrient digestibility, carcass yield, bacterial counts and identification and cost-benefit parameters in a completely randomized experimental design. Five diets were formulated with varying levels of IMO inclusion: 0 mL, 400 mL, 800 mL, 1200 mL, and 1600 mL. Weaned rabbits, with an initial weight range of 443.67g to 464.67g, were randomly assigned to one of five dietary treatments: Diet 1 (0 mL IMO), Diet 2 (400 mL IMO), Diet 3 (800 mL IMO), Diet 4 (1200 mL IMO), and Diet 5 (1600 mL IMO). These rabbits were provided with feed and water ad-libitum for a twelve-week (84 days) experimental period. Data was collected on feed intake, weight gain, blood profile, carcass and organ characteristics. The data collected was analyzed using analysis oy variance (ANOVA). The results showed that dietary treatments did not have a significant ($p>0.05$) effect on various growth performance parameters, including feed conversion ratio, protein efficiency ratio, and digestibility. Bacterial count and identification revealed that Diet 2 (400 mL IMO) had only one dominant bacterial species across the treatment groups, while Diet 3 (800 mL IMO) had similar numbers of Salmonella and Klebsiella. Importantly, the diets did not have a negative effect on cost-benefit analysis, resulting in positive net revenue for all dietary treatments: Diet 1 (₦944.07), Diet 2 (₦952.90), Diet 3 (₦894.28), Diet 4 (₦951.73), and Diet 5 (₦944.80). This study demonstrates that indigenous microorganism (IMO) can be safely incorporated into the diets of growing rabbits at levels up to 400 mL without adversely affecting growth performance, and it leads to positive net revenue for the animals.

Keywords: rabbits, growth performances, bacterial counts, cost benefit

1.0 INTRODUCTION

Rabbit is considered as superior to the other livestock because it is one of the fastest growing and its high prolificacy. It has a high production capacity and high feed conversion efficiency when compared to the other meat animals. Rabbit meat is most delicious, low in fat and cholesterol (4%), easily digestible, high in protein content (25%) and low in caloric value (160 Kcal/100 g meat) (shaahu*et al.,* 2014). Therefore, it can be consumed by heart patient and children. This livestock species has vast potential in improving the rural economy of the country by providing employment and generating income for the farmers having low and marginal land holding. In addition to these, it also plays a significant role for supply of animal protein at a cheaper cost for the overgrowing human population of the country (Mamattah, 1978). The importance and potential of this small versatile livestock has been realized by the planner's decades back, however, the development pertaining to research, extension and popularization of the species did not reach up to the expected mark. Recently, Indian reports also highlight the importance of this species for rural development programme (Das *et al*., 2005 and Risam*et. al.,* 2005). The potential of rabbit to improve food security and nutrition has been amplified by Food and Agricultural Organization and has proposed to promote rabbit farming in the various livestock projects all over the world. Rabbit production can serve as a vehicle to foster human development through the all elevation of poverty (Lukefahr, 1985) .Thus, Rabbit meat is an important source of protein , rich in precious nutrients (essentially amino acids and lipids and low in fats contents and cholesterol ((DalleZotte and Szendro ., 2011).In the last 5-6 years the Algerian Department of Agriculture has adopted a policy of diversifying animal production by encouraging rabbit farmers to invest more .Consequently high level of antibiotics have been used in food producing animals as growth promoters and for diseases prophylaxis. However, there is major problems among human consumers due to the occurrence of antibiotics resistant bacterial in animals. Therefore, the European union commission banned the use of antibiotics as growth enhancers in the diets of animals, (castanon 2007) and it is imperative to replace the overuse of antibiotics and search for a new safe alternative for health improvement and infection control in animals.

Abdel-Wareth *et al* ,(2014) recommended supplementation of growth promoters from different sourcesThe growth promoters like synthetic products e.g. chemical products, essential antibiotics, enzymes etc. play an active role in the experimental and commercial production of large and small animals (Ashour,*et al.*2014). Recently, many countries tend to prevent the application of synthetic products for their side effects on both animal and human. The ban on nutritive synthetics products and their uses in the world and the augmented awareness of the consumers triggered a need for feeding animal with live beneficial microorganism as a safe feed additive to achieve better production results of farm animals. Thus, the practice of applying beneficial bacteria to animal feedstuffs is commonly referred to as probiotic. Rabbit are fragile animal and therefore the digestive process is very complex. That is why rabbits are sensitive to enteric diseases and especially when they are exposed to negative impacts. These problems can be avoided by use of probiotics that contain yeast, live bacteria or bacterial spores instead of growth promoters with antibiotics that kill some of the rabbit own gastrointestinal flora, probiotic promote gut colonization and stabilize eubiosis by competitive growth against harmful micro-organism reducing the intestinal pH with

production of lactic acid and encouraging digestion by producing enzyme and vitamins. This function strengthen the animals own new specific immune defense (Fortun-LaMothe and Drouet-Viard, 2002). Dietary administered probiotic bacteria were effective in preventing the growth of Escherichia coli in the intestine of neonatal rabbits (Tachikawa*et al.,* 1998). Hamarany*et al* (2000) found a dose-dependent positive effect of probiotic bacterium on E. coli occurrence in the caecum and small intestine in young rabbit.Probiotic are live bacteria, they are nonpathogenic living organisms present in some foods which have positive effects on the health of the hosts if they enter the body in sufficient amounts. Imani *et al,*(2013) concluded that probiotic therapy as an inexpensive and non-invasive strategy can reduce pathophysiologic symptoms and improve various liver diseases with no complications. Thus, help prevent and treat some illnesses and promote a healthy digestive tract and immune system. However, When administered in adequate measure, give a health benefit on the host (FAO/WHO 2001). Khani*et al* (2012) reported various potential positive effects of probiotic, including the improved health of the digestive system, increased body immunity, reduced symptoms of lactose intolerance, decreased allergy, reduced risk of particular cancers, treatment of colitis, reduced serum cholesterol concentration, reduced blood pressure in those with hypertension, alleviated respiratory.

In nature, infant of animals receive protective flora from mothers or the environment. Nevertheless, contemporary childbirth and postpartum care methods limit contact with mothers and provide synthetic foods and environments. As a result, some natural parts of the micro flora of infants' digestive system, which cause resistance to diseases do not exist anymore. Diet, antibiotics, and stress also affect the flora in adults. Thus, application of probiotic supplements can compensate for this deficiency. Therefore, the use of probiotic composite does not create something, which does not naturally exist. Rather, it fully regenerates the protective ability of flora. (Matuseviciu*set al.,* 2004).At present, probiotic are classified by the US Food and Drug Administration as generally recognized as safe (GRAS) ingredients. One method considered as a natural alternative to enhancing animal productivity and improving product safety is the feeding of viable microorganisms (Brashears, *et al*., 2005). The practice of applying beneficial bacteria to animal feedstuffs is commonly referred to as probiotics; however, it is more correctly known as indigenous microorganism (**IMO**). Several definitions that describe probiotic have been used, but one commonly accepted by the World Health Organization is "live microorganisms, when administered in adequate amounts, confer a beneficial effect upon the host" (Fuller.,1992). Some definitions, however, consider feed ingredients other than bacteria, such as biologically derived extracts, including dead yeasts, essential oils, enzymes, and even seaweed, to be probiotics. Because of this lack of distinction, the US Food and Drug Administration and the Association of American Feed Control Officials mandated the term "indigenous microorganism" for the use of live microorganisms provided as a feed ingredient. Thus, in crop production IMO is consider as a distinctive approach to organic farming practice successfully in more than 30 countries, in home gardens and on a commercial scale. Amazing improvements have been seen in soil structure and plant health, as upon application of indigenous microorganisms in natural farming the soil regains its loaminess, tilth and structure, and the earthworms come in droves. When IMO is present in commercial piggeries it results

in virtually no smell. IMO are probiotic bacteria, they are *Lactobacilli* gram-positive, non-motile, non-spore forming, acid-tolerant, non-respiring rod shaped (bacillus), or spherical (crocus) bacteria which produce lactic acids as the major metabolic end-product of carbohydrate fermentation (Cho *et al*., 2009).In farm animal they confer good intestinal health by stimulating the growth of a healthy microbiota (Walter *et al*.,2008),preventing intestinal colonization of enteric pathogens *Huang et al.,* (*2004*), *Lee et al.,* (*2012*), reduced faecal noxious gas emission, production of antimicrobial substances, antibiotic resistance patterns, improving digestive ability and antibody mediated immune response, and demonstrable efficacy and safety (*Wang et al., 2012*, *Hou et al., 2015*). According to *Dunne et al.,* (*1999*) reported that Probiotics are generally host-species specific and believed to be more effective in their natural habitat i.e., target species (*Kailasapathy and Chin, 2000*). However, selection of probiotic microbes is one of the most important criteria to get a positive response in feeding of rabbit that lead to positive outcomes such as increased weight and improved feed conversion ratio (FCR).

MATERIALS AND METHODS

3.1 Experimental location

The study was conducted at thetheRabbitary Unit of The Livestockof the Teaching and Research Farm, Federal University of Agriculture, Makurdi, Benue State, Nigeria. Makurdi is located between latitude $7^0$44′N and longitude $8^0$21′E in the Guinea Savanna Zone of West Africa. The area has an annual rainfall season of between 6 - 8 months (March - October) ranging from 508 to 1016mm with minimum and maximum temperatures of 22.8^0C and maximum temperature of 40.03^0C respectively. The relative humidity ranges between 37.3 % and 59.2% (TAC, 2009).

3.2. Preparation of Test Ingredient

The test ingredient used for this experiment was the maize, rice offa, maize offal and soya beans meals with inclusion of indigenous micro-organism as growth promoter which was the test material for the experiment.

3.2.1 Collection and Processing of indigenous microorganism (IMO)

Indigenous microorganisms were produced through the following processes. The first stage, stream rice was place in a earthen pot and was covered with a clean pieces of cloth, wrapped to protect the rice from insects or rodents that may interfere or destroy the contents, this help in preventing the rice from direct sunlight and rain water before placing it under the soil. This was done to trapped Indigenous microorganisms (IMO). The earthen pot containing the rice was buried 5cm deep in the soil under a shade for 7 days. After this period, white mycelia were formed on the rice. At this stage, Indigenous microorganisms (IMO) are produced. Stage two, The Imo was mixed with molasses at the ratio of 1:1. Thus, mixing of the IMO with molasses increase the *Lactobacilli* in numbers, since they were sugar deweller. The mixture of (IMO) with molasses was placed in a cool environment away from sunlight for 7 days. After this stage, IMO is ready for used.

3.3. Experimental Animals, Management and Design

Thirty (30) mixed breeds growing rabbits within makurdi metropolis were used for the study. The rabbits were kept individually in hutches covered with wire mesh of dimensions (40x60x40cm^3). An adaptation period of 7days was used to get the animals acclimatized to their experimental site. During the adaptation period, the animals were treated against ecto and endo parasites using *Ivermectin*® and also given Enrovet antibiotics. After balancing for the initial

weight averaging 443.67g±451.30, the animals were grouped into five (5) and randomly allotted to the various dietary treatment. Each group constituted a treatment that was replicated six (6) times, using one rabbit as replicate in a CRD. The rabbits were fed and given water *ad-libitum* in aluminum drinkers so constructed to avoid wastage of feeds by the animals. The experimental design used to separate the rabbits into treatment groups was Completely Randomized Design.

T1 = Control diet at 0 ml IMO Inclusion.

T2 = IMO Inclusion at 400 ml.

T3 = IMO Inclusion at 800 ml.

T4 = IMO Inclusion at 1200 ml

T5 = IMO Inclusion at 1600 ml.

3.4 Experimental Diet

Five (5) iso-nitrogenous diets were formulated using conventional feedstuffs and indigenous microorganism as growth promoter was included at various inclusion levels of 0ml, 400ml , 800ml , and 1200ml ,1600ml in each diet. Diet 1 which served as the control diet had 0ml of the indigenous microorganism while diet 2,3 ,4 5 had indigenous microorganism as growth promoters, for optimum utilization of the diet compounded for the rabbits, experimental diets is presented in the table below

Weighed quantity of diet was given to the experimental animals,while clean water was given ad *lib*.

Experimental diet preparation and feed formulation

Ingredients (%)	Treatments				
	T1	**T2**	**T3**	**T4**	**T5**
Maize	28.00	28.00	28.00	28.00	28.00
SBM	24.00	24.00	24.00	24.00	24.00
Maize offal	21.00	21.00	21.00	21.00	21.00
Rice offal	25.00	25.00	25.00	25.00	25.00
Bone meal	1.00	1.00	1.00	1.00	1.00
Methionine	0.30	0.30	0.30	0.30	0.30
Common salt	0.25	0.25	0.25	0.25	0.25
Vit/Min.	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Imo(ml)		400	800	1200	1600
Total	100	100	100	100	100
Calculated Nutrients					
Crude protein*(%)*	15.21	15.21	15.21	15.21	15.21
Crude fibre***(%)***	12.72	12.72	12.72	12.72	12.72
Methionine*(%)*	0.53	0.53	0.53	0.53	0.53
Lysine***(%)***	0.94	0.94	0.94	0.94	0.94
Calcium***(%)***	0.82	0.82	0.82	0.82	0.82
Phosphorus(%)	0.46	0.46	0.46	0.46	0.46
ME(Kcal/kg**)**	2607.71	2607.71	2607.71	2607.71	2607.71
EE(%)	7.43	7.43	7.43	7.43	7.43

*To provide the following per kg of diet vitamin A – 15,000.00IU, Vitamin D3 3, 000,000IU, Vitamin E- 30,000IU,Vitamin K3,000mgVitamin B1 3000,mg Vitamin B2-6000mg, Vitamin B- 5,000mg, Vitamin B12-40mg, Biotin 200mg, Niacin-40,000mg, Pantothenic acid 15,000mg,Folic acid 2,000mg, choline 300,000mg,Iron 60,000mg, manganese 80,000mg, copper 25,000mg,Zinc 80,000mg cobalt 150mg,iodine 500mg.

*Imo as feed additive

Ctrl – Control
ME – Metabolizable energy
BDG – brewer dried grains
Ph – Phosphorus
Vit-min – Vitamin

3.5. PARAMETER MEASURED

3.5.1. Performance Parameters

The data collection on daily weight gain, daily feed intake and feed conversion ratio lasted for 84 days. The initial weight of the rabbits was taken at the beginning of the feeding trial and subsequently at the interval of seven (7) days using a precision digital weighing balance. Left over feeds were weighed at the end of each week and actual feed intake was obtained by difference. The average daily feed intake was computed by dividing feed intake by number of days (84 days)

(a) The average daily weight gain (ADWG) of each rabbit was determined using the formula below:

$$\textbf{ADWG} = \frac{\textbf{final weight(grams)} - \textbf{initial weight (grams)}}{\textbf{84days}}$$

(b) The daily feed intake (DFI) was determined using the formula below:

$$\mathbf{ADFI} = \frac{\mathbf{Total\ feed\ consumed\ (grams)}}{\mathbf{84days}}$$

(c) The feed conversion ratio of the rabbits was determined using the formula below:

$$\mathbf{FCR} = \frac{\mathbf{Average\ daily\ feed\ consumed\ (grams)}}{\mathbf{Average\ weight\ gained\ (grams)}}$$

3.5.2. Protein Efficiency Ratio (PER)

Protein efficiency ratio was computed by dividing bodybweight gain by protein intake

$$\text{PER} = \frac{\text{body weight gain}}{\text{protein intake}}$$

Where PI =FI×%CP

3.5.4. MicrobialCountandIdentification:

Caecum microbial samples were collected from three rabbits per replicate at the end of experiment (12 weeks of age). The Caecum were removed and placed in a sterile sample bag and put in an ice box. And kept at (-20˚C), Content of cecum samples were then diluted serially from 10-1 to 10-7. One-tenth milliliter of each diluted sample was immersed on the appropriate agar media, in duplicate for enumeration of the selected microbial populations. Bacterial counts were performed using the appropriate dilution and plate culture techniques under aerobic or anaerobic conditions according. Economics **of feeding.**

According to shaahu.,(2011), these cost were determined as follows.

The cost/kg of each was calculated as

Cost/kg diet = ∑(cost/kg ingredient ×%inclusion level in diet)/100kg

Cost of feeding was computed as a product of the cost/kg of the diet and the amount of it consumed by a rabbit during the period of study

Cost of feeding = (cost /kg diet ×total feed intake in kg).

Feed cost/kg weight gain was calculated as cost of feeding divide by the total weight gain in kg.

Feed cost/kg weight gain=Fcr ×cost/kgdiets

Total cost of production = cost of divide by 60%

Revenue = was computed as a product unit rabbit price per kg and total weight during the study.

Gross profit was calculated as total revenue minus total cost of production that is revenue minus cost of rabbits sold.GP = Revenue-Tfc.

3.5.8. Statistical Analysis:

Data collected on each parameter was subject to analysis of Variance (ANOVA), for Complete Randomized Design (CRD) using the statistical Package for Social Sciences tenth version (SPSS 16) software.

Result and Discussion

Proximate Composition of the Experimental Diets

Proximate Fractions (%)	Treatments				
	T1	T2	T3	T4	T5
Drymatter	89.43	87.24	88.69	88.99	88.04
Crude protein	18.70	19.59	19.64	17.23	18.74
Ether extract	3.70	3.84	6.49	5.32	4.19
Ash	4.83	5.19	5.08	5.10	5.03
Crude fibre	11.59	12.91	13.75	12.83	15.88
Nitrogen free extract	61.18	58.48	55.04	58.02	57.67
Metabolizable energy (kcal/kg)	3254.01	3212.74	3313.68	3269.42	3150.47

Metabolizable Energy (kcal/kg) = 37 % CP + 81 % EE + 35 % NFE 35 (0.22) CF. (Pauzenga formulae as modified by Carew 2016).

Nutrient Composition of the Experimental Diets

The nutrient composition of the experimental diets plays a critical role in determining the success of rabbit feeding. In this study, the dry matter content of the diets was found to be in the range of 88.04% to 89.43%, which is quite similar to the 91.00% dry matter content reported by Kamra*et al.* (1996) in their study on weaner rabbits fed graded levels of Lactobacillus bacterials. This consistency indicates that the diets in this study were appropriately formulated in terms of dry matter content. The crude protein content of the diets (17.23% to 19.64%) was comparable to values reported in previous studies, such as the 17.10% by Kamra*et al.* (1996), 18.50% by Amber *et al.* (2004), and 18.16% by Ewuola*et al.* (2010). These results coincide with Omole (2007) findings, emphasizing the optimal range for crude protein content in rabbit production in tropical regions. This suggests that the diets provided sufficient protein for rabbit growth. The crude fiber content, ranging from 11.59% to 15.88%, was higher than that reported by Ewuola*et al.* (2010) but within the recommended range of 10-17% according to NRC (1977). Interestingly, Cheeke (1983) pointed out that dietary fiber, even though poorly digested by rabbits, plays a role in preventing enteritis, suggesting a fiber range of 15-18% for optimal growth. The ether extract (EE) content (3.70% to 6.49%) was found to be higher than the recommended values of 2% by NRC (1977), 3% by Lebas (1980), and 2.5% recommended by Halls (2010). However, it fell within the range of 3-6% reported by Aduku and Olukosi (1990) but was lower than the range reported by Ewuola*et al.* (2010). This higher EE content might have been due to the specific ingredients used in the diet formulations. The ash content (4.83% to 5.19%) was lower than that reported by Ewuola*et al.* (2010) but similar to values reported by Oluremi and Nwosu (2002). The nitrogen-free extract (NFE) values (55.04% to 61.18%) were higher than those reported by Ewuola*et al.* (2010) but similar to values reported by Amber *et al.* (2004). The higher NFE values suggest that the diets provided sufficient carbohydrates for energy. The metabolizable energy (ME) values in the study (3150.47 - 3269.42 Kcal/kg) were higher than values reported by omole*et al.* (2007) and Amy (2010). This difference can be attributed to

variations in the processing methods and ingredients used in diet formulation.

Effect of Experimental Diets on Growth Performance of Growing Rabbit Fed Indigenous Microorganism (IMO)

The results of the growth performance of rabbits fed diets with graded levels of indigenous microorganisms (IMO) are noteworthy. It is evident that diets supplemented with probiotics, such as IMO, did not significantly affect daily feed intake, daily weight gain, or feed conversion ratio. These results align with the findings of previous studies (Jung *et al.*, 2008) that reported no significant differences in rabbit growth performance when fed probiotics.The final weight of the rabbits in the present study (1273.50 - 1405.50 g) was similar to Rabie *et al.* (2011), but higher than the range of 668.9 - 692.2 g reported by Kamra*et al.*(1996). The average daily feed intake (47.48 - 54.93 g) was in line with values reported by Oguntoye*et al.* (2017) but lower than the values reported by Amber *et al.* (2004). The average daily weight gain (9.78 - 11.20 g) in this study was lower than the 28.2 – 31.6 g reported by Amber *et al.* (2004) but similar to 7.97 -10.81 g reported by Shehu *et al.* (2014) and Oguntoye*et al.* (2017). The feed conversion ratio (4.95 - 5.11) observed in this study was better than 6.10 -7.08 reported by Shehu *et al.* (2014) and Ewuola*et al.* (2011) but higher than 4.66 -4.72 reported by Rabie *et al.* (2011) and Kamra*et al.* (1996).These results indicate that the growth performance of rabbits fed diets supplemented with IMO was similar to those on the control diet. Any discrepancies in the results could be attributed to differences in probiotic dosage, animal age and size, microbial strains, and diet composition.

Effect of the Experimental Diets on The Performance of Growing Rabbits.

Parameters	**Treatments**					
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**
Initial weight (g)	443.67	464.67	451.20	451.30	458.30	15.54^{ns}
Final weight (g)	1367.50	1405.50	1273.50	1387.83	1356.10	38.28^{ns}
Average Daily Feed intake	5291	94.93	47.48	52.74	50.57	1.18^{ns}
Average daily weight (g/day)	10.99	11.20	9.78	11.135	10.57	0.48^{ns}
Feed conversion ratio	4.92	5.01	5.41	5.11	4.94	0.24^{ns}
Protein efficiency ratio	1.13	1.04	1.12	1.21	1.24	0.40^{ns}

T1=Control (0MLof IMO), T2=400ML of IMO, T3=800ML of IMO, T4=1200 0f IMO, T5=1600 of IMO, SEM=Standard error of mean.

Bacterial Count and Identification of Rabbit fed Indigenous microorganism.

Bacterial	Treatments				
	T1(control)	T2(400ml)	T3(800ml)	T4(1200ml)	T5(1600ml)
Escherichia coli $(x10)^2$	1.33	1.53	-	1.30	9.3
Salmonella spp $(x10)^2$	1.11	-	9.6	1.00	5.7
klebsellaspp$(x10)^2$	-	-	9.6	-	-

T1=Control (0ML IMO), T2=400ML of IMO, T3=800ML of IMO, T4=1200ML of IMO, T5=1600ML of IMO.

Bacterial Count and Identification of Grower Rabbit fed Indigenous microorganism

The bacterial count and identification data showed that values for Escherichia coli, Salmonella, and Klebsiella were lower than values reported by El-shafel*et al*. (2019). This suggests that the supplementation of indigenous microorganisms (IMO) in the diets helped to maintain gut microbial balance. Such balance is essential for efficient nutrient absorption and overall gut health. Lower counts of potentially harmful bacteria like Salmonella indicate a healthier gut environment, which can contribute to improved growth and immunity (Vanbelle,2001).

Economics of Feeding

Effects of Indigenous Microorganism on Cost of Feeding Rabbits

Parameter	Treatment				
	T1	T2	T3	T4	T5
Final weight gain (kg)	1.37	1.41	1.27	1.39	1.36
Total feed intake(kg)	4.44	4.61	3.98	4.43	4.25
Total weight gain (g)	923.83	940.83	822.33	936.50	887.83
Cost per kg diet (N/kg)	150.125	151.25	152.37	153.49	154.61
Tota cost of feeding (N/kg/r)	666.56	697.26	606.43	679.96	657.09
Cost per kg weight gain (N/kg/r)	738.62	757.76	824.32	784.33	765.32
Total cost of production (₦)	1110.93	1162.1	1010.72	1133.27	1095.20
Revenue (₦)	2055	2115	1905	2085	2040
Gross profit(₦)	944.07	952.90	894.28	951.73	944. 80

T1=Control (0MLof IMO), T2=400ML of IMO, T3=800ML of IMO, T4=1200 0f IMO,T5=1600 of IMO, SEM=Standard error of mean. Revenue =1kg =1500

The economic analysis of feeding rabbits with graded levels of indigenous microorganisms indicated that the cost per kilogram of feed increased as the level of IMO increased. However, treatment 2, with a moderate level of IMO, was the most economical and resulted in higher profits compared to other treatments. This suggests that an optimal level of probiotic supplementation can improve cost-effectiveness and profitability in rabbit production. The results highlight the

importance of finding the right balance between probiotic supplementation and economic efficiency.

REFERENCE

Ashour, E A. (2014). Effect of supplementation of Yucca schidigera to growing rabbits' diets on growth performance, carcass characteristics, serum biochemistry and liver oxidative status". Asian *Journal of Animal and Veterinary Advances* 9.11 732-742.

Abdel-Wareth, A. A. A. (2014). "Effects of Khaya Senegalensis leaves on performance, carcass traits, hematological and biochemical parameters in rabbits". *EXCLI Journal* 13:502-512.

Aduku, A.O. and Olukosi, J.O. (1990): Rabbit Management in the Tropics: Production, Processing, Utilization, Marketing, Economics, Practical training, Research and Future Prospects, *LivingBookServices, G.U. Publications*

Amber, K.H., Yakout, H.M. and Hamed and Rawya, S. (2004). Effect of feeding diets containing yucca extract or probiotic on growth, digestibility, nitrogen balance and caecal microbial activity of growing New Zealand White rabbits. In Proceedings of 8th World Rabbit Congress, (pp. 737-741), Universidade De Puebla Puebla, México

Amy, E. and Halls, S. (2010). Nutritional requirement for rabbit. Shur-gain, nulreco Canada inc,

Brashears, M.M., Reilly, S.S. Gillil and, S.E. (1998). Antagonistic action of cells of *Lactobacillus lactis* toward *Escherichia coli* O157: H7 on refrigerated raw chicken meat. *Journal of Food Protection,* 61(2): 166–170.

Castanon, J.I.R. (2007). History of the use of antibiotic as growth promoters in European poultry feeds. *Journal of Poultry Science*, 86(11) 2466-2471.

Cheeke P.R. (1983). The significance of fiber in rabbit nutrition. Journal of Applied Rabbit Research, 3 (3):20-23.

Cho I. J., lee N.K, and Hahm V.T (2009) Characterization of lactobacillus spp Isolated from the faeces of breast-feeding piglets. *Journal Bioscience* 108 (3) 194-198

DalleZotte, A. and Szendro, Z. (2011). The role of rabbit meat as functional food meat Science 88;319-331.

Das G.K. Risam K.S and Bhasin V. (2005) Rabbit for meat and wool production. A review Indian *Journal of Animal Science* 75;365-82.

Dunne C., Murphy L., Flynn S., Omahony L., Ohallorans. and Feeney M. (1999). Probiotics: From myth to reality demonstration of functionality in animal models of disease and in human clinical trial Antronie van leeuwenhoek 76:279-292.

El-Sayiad, G.A., Habbeb, A.A., and Maghawty, A.M (1994). A note on the effects of breed, stage of lactation and pregnancy status on milk composition of rabbits. *Animal Production* 58, 153-157.

Ewuola, E.O., Sokunbi, O., Alaba, J. O.O. and Omoniyi, A.B. (2010). Haematology and serum biochemistry of weaned rabbits fed dietary prebiotics and probiotics. In Proceedings of the 35th Conference of Nigeria Society of Animal Production (pp. 147-150). Ibadan, Nigeria.

Fortun-Lamothe L and Drouet-Viard F (2002). Review: II Diet and immunity: Current state of knowledge and research

prospect for the rabbit. *World Rabbit Science*,10: 25-38.

FAO (2009) Food and Agriculture Organization of the United Nations.Guidelines for the evaluation of probiotics in food. Available at: ftp://ftp.fao.org/es/esn/food/ wgreport2.pdf (accessed January 27, 2009).

Fuller, R. (1992). History and development of probiotics. In: Fuller R, ed. Probiotics: The scientific basis. Dordrecht: Springer Netherlands ;1-8.

Hammarany M, Balherby M and Bepro it. (2000) use it lactobacillus plant arum-BJ0021 in growing local rabbits' rations under Algerican condition, world rabbit science 4 187-193.

Hvang C.H., Qiao S.Y., Li D.F., Piao X.S., Ren J.P (2004) Effect of lacto bacillus on the performance diarrhea incidence VFA concentration and gastrointestinal Microbial flora of weaning pigs. *Asian Aust journal Animal Science* 17:401-409.

HOUC., Zengx., Yang F., Liu H., Qiao S. (2015) study and use of the probiotic lactobacillus reuteri in mgs journal of *Animal science Biotechinology* 6:14-19.

Halls, E.A. (2010). Nutritional requirement for rabbits. Shur-Gain, Nutrco Canada Inc, Pp 1-9.

ImaniFooladi, A. A., MahmoodzadehHosseini, H., Nourani, M.R., Khani, S. and Alavian, S. M. (2013). Probiotic as a novel treatment strategy against liver disease. Hepat Mon. 13(2) 7521. doi:10.5812/ hepatmon.7521.

Jung, S.R. Houde, Baurhoo, X. Zhao and B.Lee (2008) Effect of galacto – oligosaacharide and Bifido bacteria Lactis basedprobioticstainon the growth performance and fecal micro flora of broiler chicken poult science 87, 1694 -1699.

Khani S, Mahmoodzadeh Hosseini .H, Taheri M, NouraniM.R,and Imani Fooladi A.(2012) A Probiotics as an alternative strategy for prevention and treatment of human diseases: a review. Inflammation Allergy Drug Targets.;11(2):79-89.

Kailasapathy P., and Chin J. (2000) Survival and therapeutic potential of probiotic organisms with reference to lactobacillus acidophilus and Bifido bacterium spp. Immunological cell Biology 78 (1):80-88.

Kamra D.N, Chaudhary L.C, Singh. R. and Pathak N.N (1996). Influence of feeding probiotics on the growth performance and nutrient digestibility in rabbits. *WorldRabbit Science,* 4: 85-88.

Lukefahr, S.D, and Goldman, M. (1985). A technical assessment of production and economic aspects of small-scale rabbit farming in Cameroon. *Journal of Applied Rabbit Resources*, *8:126-135.*

Lee, K.W., Y.H. Hong, S.H. Lee, M.S. Park and D.A. Bautista (2012). Effects of anticoccidial and antibiotic growth promoter programs on broiler performance and immune status. *Research in Veterinary Science 93: 721-728.*

Lebas, F., Coudert, P., Rouvier, R. and de Rochambeau, H., (1980). The rabbit: Husbandry and Health. *FAO Animal Production and Health Series, no. 21. 202 PP*.

Mamattah, N. (1978). Sociological aspects of introducing rabbits into farm practices. *Workshop on Rabbit Husbandry in Africa*, Morogoro, Tanzania, 16-21 Dec., p.93-98. Stockholm, IFS.

Matusevicius P, Sliaudaryte, R.,Antoszkiewicz Z and Bednarsk A (2004). A natural way to improve productivity of rabbits using probiotic yeasture. *Veterinarijairzootechmka*, 26, 61-64

N.R.C (1977). Nutrient Requirements of Rabbit 2nd review,Edition ,NationalAcadmyScience,USA . Pauzenga, U. (1985) Feeding parent stock zootecnia international Dec 1985 pp 22-24

Oguntoye, M.A, Mafindi U.M.,Ardo, B.A. Gangum ,I.E and Amos D.(2017), Effect of enyme supplementation on growth performance ,haematological and serum biochemical reponses of grower rabbits feds sorghum base diets .Nigeria Journal of Animal Production 2017 44(4) 279-286.

Oluremi ,O.I.A. and Nwosu ,.A.(2002). The effects of cassava peels on weanling rabbit. The Journal of Food Technology in Africa,7(1);12 -15.

Omole, A. J, Ajasin, F. O., Oluokun J. A., and Tiamiyu, A. K. (2007). Feed and feeding. Rabbit farming without tears. *Back to Agric (7) Green choice Agric. Publications. 15 – 18.*

Rabie, M. H., Sherif, Kh. El., Hussein, M. A. A., and El-Desouqi, A. R. F. (2011). Growth performance of rabbits as affected by dietary fiber level and probiotic addition during the post weaning period. *Journal Animal andPoultry Prod., Mansoura Univ., 2*(6), 185-199.

Risam KS, Das G.K, Bhatt R.S Smgh V.K 2005. Rabbit farming in diversifying livestock production and its potentials to improve agro-Co-Tourism in: National Seminar on Agro-Eco-Toursim, 19-20th January, 2015, ICAR Research complex for Goa Ela old Goa souvemir cum Abstract pp 34-35.

Shaahu, D. T. and Dzungwe, N.E. (2014). Growth performance, economic value and Carcass characteristics of rabbits fed lablab seed as major protein source in diet. *Journal of Advances in Agricultural Science and Technology*.

Shehu, B.M., Ayo, J.O., Ayawale, B.A., Jiya, E.Z. and Tsado, D.N. (2014). Growth performance and nutrient digestibility of weaned rabbits fed diets supplemented with varying levels of baker yeast (saccharomyces cerevisae) Volume 17(1) 1619-1627, 2014. *International Journal of Agriculture and Rural Development*

Tactical Air Command (TAC) (2009). Makurdi Weather Elements Records, Makurdi Metereological Station. Nigerian Airforce, Tactical Air Command, Makurdi, Nigeria.

Tachikawa T, Seo G, Nakazawa M, Sueyoshi M, Ohishi T and Joh K (1998). Estimation of probiotics by infection model of infant rabbit with enterohemorrhagic *Escherichia coli* O157: H7. *Journal of JapaneseAssociation Infections Diseases,* 72: 1300-1305.

Vanbelle, M. (2001). Current status and future perspectives in Eu. for antibiotics, probiotics enzymes and organics acids in animal nutrition in priva A batch Knudsen K.E. Lindberg J.E, gut environment of pigs. Nottingham university press Uk app 231 - 256.

Walter J., Schwab C., Loarh D.M Ganzil M.G., Tannnock G.W 2008 Glucosyltransferase A (GTFA) and Inulosucrase (Inu) Of Lacto Bacillus Reuteri TMW1106 contribute to cell aggregation involve biofilm formation and colonization of the mouse gastrointestinal tract microbiology 154:72-80.

Waly, A.H., Abo, El-Azayem, E.H., Younan, G.E., Zedan, A.H. EL-kom, H.M.A. and Mohamed R.A. (2021). Effect of Propolis Supplementation on Growth Performance Nutrients Digestibility, Carcass Characteristics and Meat Quality Of Growing New Zealand Rabbits. *Egypt Journal of Nutrient Feeds*. 2021;24-65-73.