PERFORMANCE RESPONSE AND CARCASS CHARACTERISTICS OF BROILERS FED DIETARY ANTIBIOTICS, PROBIOTICS AND PREBIOTICS

Toluwase Righteous Odefemi

Student, Department of Animal Science, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria.

ABSTRACT: *An experiment was conducted for six weeks to investigate the effect of antibiotics, probiotics and prebiotics as feed additives in broiler diets to check for their effects on performance and carcass characteristics. A total of 250 unsexed Abor-acre broiler chicks were randomly allotted into 5 treatment groups containing 5 replicates with 10 birds per replicate. All birds were subjected to the same environmental conditions. The treatments were assigned into 5 dietary treatments containing 0.01% antibiotics, 0.06% probiotics, 0.1% probiotics and 0.2% prebiotics while the first treatment which served as the control did not include anything. Parameters on performance (feed intake, weight gain, feed conversion ratio and the feed efficiency ratio) and carcass characteristics (live and dressed weight, head, neck, breast, back, wings, drumsticks, thigh, shank, gizzard, lungs, liver, spleen, heart and bursa of fabricius) was evaluated. Data were subjected to analysis of variance (ANOVA) procedure of SAS, 2010. It was observed that birds fed with probiotics had the highest weight gain (1218.15g and 1163.68g) and high feed intake, relatively high weight in wings when compared with other treatments. The inclusion of probiotics at certain level increases growth performance, relatively high value in some parts of carcass and the values are closer to those fed antibiotics. It thus shows that probiotics can be used to replace antibiotics.*

KEYWORDS: Broiler, Antibiotic, Probiotic, Prebiotic.

INTRODUCTION

Since the 1950s, antibiotics have been widely and globally used in various aspects of livestock production most especially in poultry production (Aarestrup *et al.*, 2008). They are used for many purposes, including the therapeutic treatment of clinically sick animals, for disease prophylaxis during period of high risk of infection, and for promotion of growth and feed efficiency. Food animals are raised in groups or herds, often in confined conditions that promote the spread of infectious diseases.

The World Health Organization (WHO) reported that antibiotics are frequently used to compensate for poor production practices. Most of the antibiotics used in feeding animals are the same as those used in humans (WHO, 1997; National Academy of Sciences NAS, 1999). Antibiotics are used in all of the major (cattle, pigs, poultry) and minor (e.g. sheep, goats) land-based species and in aquaculture (e.g. salmon, trout) and are administered for therapy, prophylaxis (prevention) and growth promotion or increased feed efficiency (McEwen *et al.*, 2002).

With increasing concerns about antibiotic resistance, there is increasing interest in finding alternatives to antibiotics for poultry production. There is considerable controversy over the use of human antibiotics to promote growth in animals raised for food (Smith, 2002). The World Health Organization, the American Medical Association (AMA), and the American

Public Health Association (APHA) have urged a ban on growth promoting antibiotics (GPAs), arguing that their use leads to increased antibiotic-resistant infections in humans. In contrast, commercial interests have argued that their removal will have a significant impact on the cost of production and is unlikely to affect the risk to humans from antibiotic-resistant infections.

The use of antibiotics to enhance growth and feed efficiency and reduce mortality in broiler production was introduced without rigorous testing as to efficacy some 50 years ago (Waibel *et al*., 1957). Improvement in growth due to antibiotics was first described in the mid-1940s, and within five years the addition of GPAs became common practice. During this initial period, it was hypothesized that the antibiotic growth effect was due to the reduction of pathogenic bacteria in the intestinal tract of chicks (Jacobs *et al*., 1953).

Increased bacteria resistance to antibiotics in humans has caused an increase in public and governmental interest in eliminating sub-therapeutic use of antibiotics in livestock. An alternative approach to sub-therapeutic antibiotics in livestock is the use of probiotic microorganisms, prebiotic substrates that enrich certain bacterial population, or symbiotic which is the combination of prebiotics and probiotics.

Prebiotic is defined as a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and /or activity of one or a limited number of bacteria in the colon (Gibson *et al.*, 1995). Recently, some researches (Houdijk *et al.*, 1998; Hillman, 2001) have been conducted to manipulate beneficial bacteria in gastrointestinal tract (GIT).

Gong *et al.* (2002) defined probiotics as health-promoting bacteria inhabiting the gastrointestinal tract of humans and animals. The major probiotic strains include *Lactobacillus, Saccharomyces, Bacillus, Streptococcus* and *Aspergillus* (Tannock, 2001). Positive effects of probiotics on animals can result either from a direct nutritional effect of the probiotic, or a health effect, with probiotics acting as bio regulators of intestinal micro flora and reinforcing the host’s natural defenses. There have been numerous studies in humans and animals on the ability of probiotics to change the types and numbers of gut micro flora (Endo *et al.*, 1999).

MATERIALS AND METHOD

A total of two hundred and fifty day old chicks were procured. Upon arrival, the birds were tagged and randomized into five treatment and five replicates with ten birds in each replicate, they were checked for signs of abnormalities before placing them in their allocated pens and were raised for 42 days.

The birds were raised in an environmental temperature except during the first 2 weeks of brooding and adequate ventilation was provided. Except for the first two days that anti-stress was administered orally, only the administration of appropriate vaccines was strictly adhered to.

The experimental diets were formulated both at the starter and finisher phases. The inclusion of antibiotics, prebiotics and probiotics in the diet varies as follow:

Diet 1 = Negative control = 0% antibiotics, probiotics and prebiotics
Diet 2 = Positive control = 0.01% antibiotics
Diet 3 = Negative control + 0.06% probiotics 1 (Bio grow promoter)

ISSN 2054-6319 (Print), ISSN 2054-6327(online)

Diet 4 = Negative control + 0.1% probiotics 2 (Grow up)
Diet 5 = Negative control + 0.2% prebiotic (Manna oligosaccharide)

Table 1: Gross composition of starter diet

Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Corn	55.02	55.00	54.90	54.82	54.62
Soyabean meal	36.10	36.10	36.10	36.10	36.10
Soya oil	4.87	4.87	4.87	4.87	4.87
Dicalcium phosphate	1.85	1.85	1.85	1.85	1.85
*Vit-Min premix	0.16	0.16	0.16	0.16	0.16
Limestone	1.35	1.35	1.35	1.35	1.35
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25	0.25
Antibiotics	0	0.01	0	0	0
Probiotics 1	0	0	0.06	0	0
Probiotics 2	0	0	0	0.10	0
Prebiotics	0	0	0	0	0.20
Total	100	100	100	100	100
Calculated analysis (%)					
Crude protein	22.17	22.17	22.17	22.17	22.15
Energy ME, (Kcal/kg)	3050.58	3050.23	3050.23	3050.23	3043.88
Ether extract	3.46	3.46	3.45	3.45	3.45
Crude fiber	3.73	3.73	3.73	3.73	3.73
Calcium	1.02	1.02	1.02	1.02	1.02
Total phosphorus	0.70	0.70	0.70	0.70	0.70
Non-phytase phosphorus	0.45	0.45	0.45	0.45	0.45
Ca:NPP	0.23	0.23	0.23	0.23	0.23
Ca:P	0.15	0.15	0.15	0.15	0.15

*Supplied the following per kg diet: vitamin A, 5484 IU; vitamin D_3, 2643 ICU; vitamin E, 11 IU; menadione sodium bisulfie, 4.38 mg; riboflavin, 5.49 mg; d-pantothenic acid, 11 mg; niacin, 44.1 mg; choline chloride, 771 mg; vitamin B_{12}, 13.2 ug; biotin, 55.2 ug; thiamine mononitrate, 2.2 mg; folic acid, 990 ug; pyridoxine hydrochloride, 3.3 mg; I, 1.11 mg; Mn, 66.06 mg; Cu, 4.44 mg; Fe, 44.1 mg; Zn, 44.1 mg; Se, 300 ug

Table 2: Gross composition of finisher diet

Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Corn	60.13	60.12	60.07	60.03	59.93
Soyabean meal	34.0	34.00	34.00	34.00	34.00
Soya oil	3.00	3.00	3.00	3.00	3.00
Dicalcium phosphate	1.20	1.20	1.20	1.20	1.20
*Vit-Min premix	0.16	0.16	0.16	0.16	0.16

ISSN 2054-6319 (Print), ISSN 2054-6327(online)

Limestone	1.10	1.10	1.10	1.10	1.10
Methionine	0.08	0.08	0.08	0.08	0.08
Lysine	0.08	0.08	0.08	0.08	0.08
Salt	0.25	0.25	0.25	0.25	0.25
Antibiotics	0	0.01	0	0	0
Probiotics 1	0	0	0.06	0	0
Probiotics 2	0	0	0	0.10	0
Prebiotics	0	0	0	0	0.20
Total	100	100	100	100	100
Calculated analysis (%)					
Crude protein	20.07	20.07	20.07	20.06	20.05
Energy ME, (Kcal/kg)	3024.56	3024.20	3024.20	3021.21	3024.20
Ether extract	3.60	3.60	3.60	3.60	3.59
Crude fiber	3.70	3.70	3.70	3.70	3.70
Calcium	0.78	0.78	0.78	0.78	0.78
Total phosphorus	0.58	0.58	0.58	0.58	0.58
Non-phytase phosphorus	0.33	0.33	0.33	0.33	0.33
Ca:NPP	0.24	0.24	0.24	0.24	0.24
Ca:P	0.13	0.13	0.13	0.13	0.13

*Supplied the following per kg diet: vitamin A, 5484 IU; vitamin $D_{3,}$ 2643 ICU; vitamin E, 11 IU; menadione sodium bisulfie, 4.38 mg; riboflavin, 5.49 mg; d-pantothenic acid, 11 mg; niacin, 44.1 mg; choline chloride, 771 mg; vitamin $B_{12,}$ 13.2 ug; biotin, 55.2 ug; thiamine mononitrate, 2.2 mg; folic acid, 990 ug; pyridoxine hydrochloride, 3.3 mg; I, 1.11 mg; Mn, 66.06 mg; Cu, 4.44 mg; Fe, 44.1 mg; Zn, 44.1 mg; Se, 300 ug

RESULT AND DISCUSSION

Table 3 revealed no significant ($p>0.05$) difference in the final body weight of birds fed dietary antibiotics, prebiotics and probiotics. However, birds fed diet supplemented with probiotics (diets 3 and 4) had the highest final body weight means of 1838.46g and 1821.95g respectively compared to diet 1 which served as the negative control with final weight of 1725.58g. Significant ($p<0.05$) difference was however observed in the weight gain with diets 3 and 4 having the highest means of 1218.15g and 1163.68g respectively.

The result of carcass characteristics of broiler chickens is as shown in table 5 and is expressed as percentage live weight. There is significant ($p<0.05$) difference in live and dressed weight with diet supplemented with antibiotics, probiotics and prebiotics. Diets 1 and 2 (control and diet supplemented with antibiotics) had the highest means of 2130 and 2180 for live weight; 1870 and 1910 for dressed weight respectively.

ISSN 2054-6319 (Print), ISSN 2054-6327(online)

Table 3: Performance characteristics of broiler birds fed antibiotics, prebiotics and probiotics at starter phase (day 0-21)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Initial weight (g/bird)	39.72	39.73	39.70	47.39	39.72	
Final weight (g/bird)	623.48^{ab}	624.78^{ab}	588.93^{b}	650.44^{a}	628.46^{ab}	57.19
Weight gain (g/bird)	583.40^{ab}	585.14^{ab}	549.62^{b}	610.78^{a}	588.90^{a}	57.18
Feed Intake (g/bird)	538.93^{b}	533.70^{b}	490.00^{c}	566.00^{a}	527.80^{b}	23.4
Feed Conversion Ratio	0.97	0.96	0.92	0.96	0.96	0.10

^{abc}Means on the same row with different superscripts are significantly different (p<0.05)

Table 4: Performance characteristics of broiler birds fed antibiotics, prebiotics and probiotics at finisher phase (day 22-42)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Initial weight (g/bird)	623.48^{ab}	624.78^{ab}	588.93^{b}	650.44^{a}	628.46^{ab}	57.19
Final weight (g/bird)	1725.58	1775.00	1838.46	1821.95	1713.16	47.22
Weight gain (g/bird)	1108.65^{ab}	1140.55^{ab}	1218.15^{a}	1163.68^{ab}	1096.03^{ab}	105.97
Feed Intake (g/bird)	1960.12^{ab}	1880.89^{b}	1930.77^{b}	2070.24^{a}	1897.57^{b}	119.90
Feed Conversion Ratio	1.84^{a}	1.74^{ab}	1.64^{b}	1.84^{a}	1.77^{ab}	0.16

^{ab}Means on the same row with different superscripts are significantly different (p<0.05)

Table 5: Carcass characteristics of broiler birds fed antibiotics, prebiotics and probiotics

Parameters (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Live weight	2130.00^{ab}	2180.00	2080.00^{ab}	2100.00^{ab}	1960.00^{b}	84.14
Dressed weight	1870.00	1910.00	1860.00	1860.00	1760.00	80.90
Head	2.55	2.42^{ab}	2.24	2.40^{ab}	2.37^{ab}	0.13
Neck	4.87	5.06	4.82	5.21	4.80	0.55
Breast	19.81	20.54	20.32	19.81	20.10	1.00
Back	15.08	14.21	14.43	13.76	13.44	0.95
Wings	7.32	7.43	7.49	7.46	7.70	0.37
Drumstick	9.97	9.18	11.21	10.10	9.32	0.97
Thigh	9.10	9.46	9.38	9.74	10.02	0.58
Shank	4.08	4.04	3.93	4.26	4.24	0.19
Full gizzard	3.22	3.19	3.12	3.11	3.28	0.21
Empty gizzard	2.26	2.24	2.05	2.19	2.36	0.15
Lungs	0.50	0.50	0.53	0.45	0.43	0.04
Liver	2.05	2.15	2.07	2.04	2.23	0.10
Spleen	0.12	0.10	0.11	0.10	0.10	0.01
Heart	0.56	0.58	0.52	0.53	0.50	0.04
Bursa of fabricius	0.22	0.21	0.21	0.20	0.24	0.03

^{ab}Means on the same row with different superscripts are significantly different (p<0.05)

From the result in tables 3 and 4, body weight of birds fed with probiotics can be compared to have numerical values when compared with the control at the starter phase (day 0-21). However, between day 22 and 42, body weight was seen to have been affected by probiotics. This showed that birds fed diets 3, 4 and 5 had higher weight gain when compared with the

ISSN 2054-6319 (Print), ISSN 2054-6327(online)

negative control. The result shows that weight of the group receiving probiotics was highest at the finisher phase (1834.46g and 1821.95g), the finisher data when compared with the starter phase showed that there is a lag phase of 21 days before the effects of the probiotic preparation (Sinovec *et al*., 1998).

This can be associated to the fact that they are live microorganisms that claims to be beneficial to humans and animals and maintains a balance of micro flora in the digestive tract (Goldin, 1998).

Besides, these microorganisms are responsible for production of vitamins of the B complex and digestive enzymes, and for stimulation of intestinal mucosa immunity, increasing protection against toxins produced by pathogenic microorganisms (Goldin, 1998). This is in accordance with Awad *et al.,* (2009) who reported that addition of probiotics improved the final weight and weight gain. Samad *et al.,* (2011) also reported that weight gain was significantly improved in probiotics which also conforms to the findings of this experiment.

Feed conversion ratio (FCR) at the finisher phase was lower numerically for birds supplemented with probiotics than birds in the other treatments but had no significant difference from diets containing prebiotics and the diet serving as the negative control at ($P< 0.05$). This is because probiotic produces enzymes that improve feed intake, digestion and feed conversion ratio in broiler. This agrees with Chiang and Hsieh (2005) which stated that dietary probiotic suppressed the growth of bacteria and produces enzyme which increases the feed intake and is responsible for the increased weight gain in the birds fed with probiotics.

The result presented in table 5 showed the parts investigated for primal cuts which were head, neck, breast, back, wings, drumsticks, thighs and shanks. There was no significant ($p>0.05$) difference on weight of the parts of the primary cuts except for head, back and drumsticks which had significant ($p<0.05$) difference across the diets. Diets supplemented with probiotics had higher weight of drumsticks, improved performance of chickens fed probiotics might be associated with the partial replacement of intestinal micro flora by probiotics added Jin *et al.*, (2000).

Supplementing diets of broilers did not affect the weights of different organs. In this experiment, a significant ($p<0.05$) difference and numerical decreases were observed to be due to addition of antibiotics, probiotics and prebiotics to the diet, these findings are in agreement with results of Fethiere and Miles (1987). Peter *et al*., (2005) however concluded that intermittent feeding had no significant difference on carcass weight.

The weight of gizzard, liver and bursa of fabricius did not show any significant difference ($P>0.05$) between experimental groups. This is in agreement Behrouz *et al.,* (2012) who reported that weights of gizzard, liver and bursa of fabricius were not affected significantly by addition of prebiotics, probiotics and antibiotics.

Also, it was seen that the spleen weight did not show any significant effect between probiotics, prebiotics and antibiotics. However, Awad *et al.,* (2009) reported that addition of probiotics, prebiotics and antibiotics to broiler diets was significantly different between probiotic and prebiotic groups.

ISSN 2054-6319 (Print), ISSN 2054-6327(online)

CONCLUSION

In conclusion, the result of the study shows that probiotics displayed a growth-promoting effect and offers a good alternative to improve performance and small intestinal morphology of broiler birds. Therefore, probiotics have the potential to be applied as effective substitutes for in-fed antibiotics.

REFERENCES

Aarestrup F.M., Seyfarth A.M., Emborg H.D., Pederson K., Henderiksen R.S. and Bagenf 2001: Effect of abolishment of the use of antimicrobial agents for growth promotion and occurrence of antimicrobial resistance in faecal *enterococci* from food animals in Denmark. Antimicrobial Agents and Chemotherapy 45: 2054-2059.

Adeoye, D.A. 2012: *Chanca piedra* (*Phyllantus amarus)* leaf meal as a feed additive in broiler diet.

Ammerman, E., Quarles, C. and Twining, P.V., 1989: Evaluation of fructo oligosaccharideson performance and carcass yield of male broilers. *Poult. Sci*., 68:167-167.

Anon. 2006: Antibiotics in Food Animal Production: A Forty year Debate. Alliance forPrudent Use of Antibiotics Dec.15:28(2)

AOAC, 1990: Association of Official Analytical Chemists, Official Methods of Analysis,15th Edition. Arlington, VA Association of Official Analytical Chemists, Official Methods of Analysis, 15th edn. AOAC, Arlington,VA, 1990.

Awad, W. A., Ghareeb, K., Abdel-Raheem, S. & Bohm, J., 2009: Effects of dietary inclusion of probiotic and synbiotic on growth performance, organ weights, and intestinal histomorphology of broiler chickens. *Poult. Sci*. 88, 49-55.

Bailey, J.S., L.C. Blankenship and N.A. Cox, 1991. Effect of fructodigosaccharide on *Salmonella* colonization of the chicken intestine. *Poult. Sci*., 70: 2433-2438.

Barrow, P.A. 1992 Probiotics for chickens, in: R. FULLER (Ed.) Probiotics: The scientific basis, pp. 255- 257 (Chapman and Hall, London).

Bedford, M. R. 2000. Removal of antibiotic growth promoters from poultry diets: Implications and strategies to minimize subsequent problems. *World's Poultry Science Journal 56: 347-365*

Bedford, M.R. 2001. The role of carbohydrases in feedstuff digestion, in: MCNAB, J. & Boorman, K. N. (Eds) Poultry feedstuffs: Supply, composition, and nutritive value, pp. 319-336 (CAB international, Edinburgh, UK).

Dibner, J.J. and Richards, J.D. 2005: Antibiotic growth promoters in agriculture: History and mode of action. *Poultry Science* 84: 634-643

Food and Drug Administration. 1992 Bacteriological Analytical Manual. 7th Edition.Dietary modulation of the human colonic microbiota: Introducing the concept of prebiotics.

Fethiere, R. and Miles, R. D. 1987: Intestinal Tract Weight of Chicks Fed an Antibiotic and Probiotic. *Nutr. Rep. Int.*, 36: 1305-9.

Flickinger, E.A. and G.C. Fahey Jr., 2002: Pet food and feed applications of inulin, oligofructose and other oligosaccharides. *Br. J. Nutr.*, 87: S297-S300.

Fritts, C. A., J. H. Kersey, M. A. Motl, E. C. Kroger, F. Yan, J. Si, Q. Jiang, M. M. 2003: Evaluation of Bio-Mos Mannan Oligosaccharide as a Replacement For Growth Promoting Antibiotics in diets For Turkeys, *International Journal of Polutry Science*, 2(1), 19-22

Fuller, R., 2001 Probiotics-The Scientific Basis, Chapman and Hall, London, UK.

ISSN 2054-6319 (Print), ISSN 2054-6327(online)

Ghiyasi, M., M. Rezaei and H. Sayyahzadeh, 2007. Effect of prebiotic (Fermacto) in low protein diet on performance and carcass characteristics of broiler chicks. *Int. J. Poult. Sci.*, 6: 661-665.

Gibson, G. R. and M. B. Roberfroid. (1995): Dietary modulation of the human colonic microbiota: Introducing the concept of prebiotics. *J. Nutr.* 125:1401–1412.

Gibson, G. R. 1999: Dietary modulation of the human gut microflora using the prebiotics oligofructose and inulin. *J. Nutr*. 129:1438S–1441S. 8.

Gibson G.R, Fuller F. 2000: Annuals of Biological Research ,*J.Nutr*,130:391-395

Gibson GR, Roberfroid 2008: MB. Handbook of probiotics. CRC press, Tylor and Francis group, USA. 2008; 485pp.

Goldin, B.R. 1998: Health benefits of probiotics. *British Journal of Nutririon,* 8-(2):203-207.

Gong, J. Forster, R.J. Yu, H. Chambers, J.R. Wheatcraft, R. Sabour, P.M. and Shu, C. 2002: Molecular analysis of bacterial populations in the ileum of broiler chickens and comparison with bacteria in the cecum. FEMS Microbiol. Ecol., 41:171-179.

Gould, I.M., 2008: The epidemiology of antibiotic resistance. *Int. J. Antimicrob. Agents, doi*;10.1016/ j.ijantimicag. (In press, accessed 15 Sept. 2008).

Griggs, J.P. and Jacob, J.P. 2005: Alternatives to antibiotics for organic poultry production. *Journal of Applied Poultry Research*, 14:750-756.

Hajati O., Jadamus, A. and Vahjen, W. 2010: Probiotic feed additives—effectiveness and expected modes of action. *Journal of Animal and Feed Sciences 10*: 51-67.

Harms, R.H. and R.D. Miles, 1988: Research note: Influence of fermacto on the performance of laying hens when fed with different levels of methionine. *Poult. Sci.*, 67: 842-844.

Hatemink, R., 1995. Non digestible oligosaccharides: Healthy food for the colon. Proceedings Symposium Wageningen, 4-5 December, pp: 1-177.

Havenaar, R. and Huis I.N 'T Veld, M.J.H. 1992: Probiotics: a general view, in:Wood,

B.J.B. (Ed.) Lactic acid bacteria, Vol. 1. pp. 151-170 (Elsevier Applied Science Publishers, Amsterdam).

Hooge, D. 2003 Dietary alternatives for improving live performance of antibiotic-free poultry. Accessed in 2006. www.feedinfo.com.

Huyghebaert, G. 2003: Replacement of antibiotics. Proceedings of the Eastern Nutrition Conference; 2003; Quebec. Canada.

Huyghebaert 2003: Bacteriological Aspects of the Use of Antibiotics and Their Alternatives In the Feed of Non-ruminant Animals. In: Recent Advances in Animal Nutrition, Garnsworthy, P.C. and J. Wiseman (Eds.). Nottingham University Press, Nottingham, pp: 107-134.

Hooge, D. 2004a: Meta-analysis of broiler chicken pen trials evaluating dietary manna oligosaccharide, 1993-2003. *International Journal of Poultry Science* 3: 163-174.

Hooge, D. 2004b: Dietary alternatives for improving live performance of antibiotic-free poultry. Accessed in 2006. www.feedinfo.com.

Houdijk, J.G.M., 1998: Effects of non-digestible Liescher, S., 1961. Sind Die Darme Des Mit

Muttermilch oligosaccharides in young pig diets. Ph.D. Thesis Wageningen University, pp: 1 141.

Klis, F.M., P. Mol, K. Hellingwerf and S. Brul, 2002: Dynamics of cell wall structure in *Saccharomyces cervisiae*. FEMS Microbiol. Rev., 26: 239-247.

Kim, S.H., S.Y. Park, D.J. Yu, S.L. Lee, K.S. Ryu and D.G. Lee, 2003: Effects of feeding Aspergillus oryzae ferments on performance, intestinal microbiota, blood serum components and environmental factors in broiler. *Korean J. Poult. Sci.*, 30: 151-159.

L.T. Ortiz, M.L. Rodriguez, C. Alzueta, A. Rebole, J. Trevino, *Br. Poult. Sci*., 2009: 50:3, 325-332. N. Salianeh, M.R. Shirzad, S. Seifi, *J. Appl. Anim. Res.*, 2011, 39:1, 65-67.247.

McEwen, S.A. & Fedorka-Cray, P.J. 2002. “Antimicrobial use and resistance in animals.”Clin Infect Dis 34(Supplement 3): S93-S106

Mellor 2009: Alternatives to antibiotics. Pig progress, 16: 18-21

Midilli, M., M. Alp, N. Kocabagli, Ö.H. Muglali, N. Turan, H. Yilmaz and S. Çakir, 2008: Effects of dietary probiotic and prebiotic supplementation on growth performance and serum IgG concentration of broilers. South Afr. *J. Anim. Sci.,* Vol. 38.

National Academy of Sciences. 1999. The use of drugs in food animals, benefits, and risks. Committee on Drug Use in Food Animals. Washington, D.C.: National Academy Press.

National Institute of Animal Agriculture, NIAA, 2011. Use of Antibiotics in Food Animal Production, *White Paper*, Chicago, USA.

NRC, (1994): National Research Council Nutrient requirement of poultry 9th revised edn National nutrient retention production parameters of laying pullets. Poult. Sci. 71(suppl.1):111.

Ogbe, A.O. and Affiku, J.P. 2012: Proximate Study, Mineral and Anti-Nutrient Composition of Moringa Oleifera Leaves Harvested from Lafia, Nigeria: Potential Benefits In Poultry Nutrition And Health. Journal of Microbiology, Biotechnology and Food Sciences 1(3):296-308.

Ortiz L.T., Rodriguez M.L., Alzueta C., Rebole A., J. Trevino, *Br. Poult. Sci*., 2009, 50:3, lactobacilli and their role in protection against microbial pathogens. FEMS Immunol. Medicine Microbiol., 34: 245-253.

Savage, T.F., E.I. Zakrzewska and J.R. Andreasen, 1997: The effects of feeding mannan oligosaccharide supplemented diets to poults on performance and the morphology of the small intestine. *Poult. Sci.*, 76 (Suppl. 1): 139 (Abstr.).

Smith JA. 2002 The future of poultry production in the USA without antibiotics. *Poultry International* 2002;41:68-9.

Song, J.Y. and Li, W.F. 2001: The preparation of manna-oligosaccharide from *Saccharomyces cerevisiae*

Spring, P., Wenk, C., Dawsom, K.A. and Newman, K.E. 2000 the effects of dietary manno oligosacharrides on cecal parameters and the concentrations of enteric bacteria in the ceca of *Samolenna*-chanllenge broiler chicks. Poultry Science 179, 205-211.

Stainer, T. 2006: The potential benefits of national growth promoters. Feed Tech. 10:26-28.

Stavric, S. and E. T. Kornegay. 1995. Microbial probiotics for pigs and poultry. Pages 205–231 in Biotechnology in Animal Feeds and Animal Feeding. R. J. Wallace, and A. Chesson, ed. VCH, New York Tierzucht 51: 64-70.

Stavric U.I, Kornegay, J., 1995: Effects of dietary inclusion of probiotic and synbiotic on growth performance, organ weights, and intestinal histomorphology of broiler chickens. *Poult. Sci*. 88, 49-55.

Stobbering, E., A.E. Van den Bogaard, N. London, C. Driessen, J. Top and R. Williams, 1999. *Enterococci* with glycopetidic resistance in turkeys, turkey farmers, turkey slaughterers and (sub) urban residents in the South of The Netherlands: evidence for transmission of vancomycin resistance from animals to humans? Antimicrob. Agents. Chemother, 43: 2215-2221.

Tannock, G.W. 2001. Probiotics and probiotics: Scientific aspects. Caister Academic Press: the 12th European Symposium on Poultry Nutrition, Veldhoven, The Netherlands: WPSA Dutch Branch, pp: 193-201.

Van den Bogaard, A.E. and E.E. Stobberingh, 2000. Epidemiology of resistance to antibiotics. Links between animals and humans. *Int. J. Antimicrob. Agents.*, 14: 327-335.

Walker, W.A. and Duffy, H.C. 1998: Diet and bacterial colonization: role of prebioics and probiotics. *The Journal of Nutritional Biochemistry* 9,668-675.

Watkins, B.A and Kratzer, F.H. 1984: Drinking water treatment with commercial preparation of a concentrated Lactobacillus culture for broiler chickens. *Poult. Sci.,* 63:1671-1673.

Williams, B.A., Verstegen, M.W.A. and Tamminga, S. 2001 Fermentation in the large intestine of single-stomached animals and its relationship to animal health. Nutrition Research Reviews 14: 207-227.

Willis, W.L., I. Goktepe, O.S. Isikhuemhen, M. Reed, K. King and C. Murray, 2008: The Effect of mushroom and pokeweed extract on salmonella, egg production and weight loss in molting hens. *Poult. Sci*., 87: 2451-2457.

World Health Organisation 1997: Technical Report Series, No. 842 (Expert Committee on Medical Assessment of Nutritional Status). WHO Geneva 1997.

Xu, Z.R., Hu, C.H., Xia, M.S., Zhan, X.A. & Wang, M.Q., 2003: Effects of dietary fructo oligosaccharide on digestive enzyme activities, intestinal microflora and morphology of male broilers. *Poult. Sci*. 82, 1030-1036.

Yang, Y., P.A. Iji, and M. Choct. 2007: Effects of different dietary levels of manna oligosaccharide on growth performance and gut development of broiler chickens. Asian-Australas. *J. Anim. Sci.* 20:1084–1091.

Zhang, W.F., Li, D.F., Lu, W.Q. and Yi, G.F. 2003: Effects of isomalto-oligosaccharides o broiler performance and intestinal microflora. *Poultry Science* 82: 657-663.

Zikic, D., L. Peric, G. Uscebrka, S. Stojanovic, D. Milic and L. Nollet, 2008: Effect of prebiotics in broiler breeder and broiler diets on performance and jejunum morphology of broiler chickens. 1st Mediterranean Summit of WPSA, Book of Proceedings, Porto Carras, Greece, pp: 879-882.

ISSN 2054-6319 (Print), ISSN 2054-6327(online)