

**Effect of Baker's yeast (*Saccharomyces cerevisiae*)
inclusion in feed and in drinking water on performance of broiler birds**

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Abstract

Aim: This study was designed to investigate the effect of Baker's yeast (*Saccharomyces cerevisiae*) inclusion in feed and in drinking water on the performance of broiler birds.

Study design: Yeast in feed and in drinking water were laid out in Completely Randomized Design while yeast in water/feed was a factorial experiment (2 factors: level and route of application) with 5 application levels. Each study was replicated 3 times.

Place and duration of study: The study was carried out at the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, Nigeria. The study lasted for 8 weeks.

Material and Methods: 450 Anak broiler chicks were used for the study. 150 chicks each for yeast in feed, yeast in drinking water and in feed/drinking water. Graded levels (0.5g kg⁻¹/l⁻¹, 1.0g kg⁻¹/l⁻¹, 1.5g kg⁻¹/l⁻¹ and 2.0g kg⁻¹/l⁻¹ of feed and drinking water given *ad libitum* only by day to chicks and through the finisher phase. They were fed broiler starter during the starter period and broiler finisher during the finisher period. They were allowed to run together on deep litter for acclimatization before separation into 5 groups with 3 replications each. Feed was fed by day only while drinking water was given *ad libitum*. Diets were formulated using Excel feed formulation and feeding models (Onwurah, 2011) and analyzed using Association of Official Analytical Chemists (AOAC, 2000) while all data were analyzed using Statistical Package for Social Sciences (SPSS, 2006).

Results: Broiler birds that received yeast supplementation in feed performed better than those with supplementation in water. Supplementation in both feed and water had no additive effect. Best results were in yeast inclusion levels of 1.0g yeast in feed and in drinking water. There was no interaction in yeast fed in water and in feed and therefore has no additive effect.

Conclusion: Best results were in yeast inclusion levels of 0.5g and 1.0g. This study recommends 0.5g yeast inclusion in feed.

Key words: Yeast, Performance, Yeast inclusion and Anak broiler.

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43 **Introduction**

44 To meet poultry products requirements of Nigerians, there is the need to expand the
45 industry. This goal according to Babatunde and Hamzat (2005) depends to a large extent on
46 the **availability** of good quality feed in sufficient quantity and affordable prices that farmers
47 could afford. According to Ibiyo and Atteh (2005), the cost of poultry feed has been on the
48 increase and could constitute up to 80% of the total production cost. Yeast (*Saccharomyces*
49 *cerevisiae*) appears potentially useful as it has been shown to improve feed digestibility and
50 meat colour (Ezema *et al.*, 2009). Yeast has also been reported as a feed quality enhancer
51 as it has anti-microbial properties (National Livestock Research Institute, 2007) and may be
52 a good alternative to antibiotic growth promoters (Shen *et al.*, 2009). Live yeast augments
53 digestive processes by initiating the process of fermentation, and a source of digestive
54 enzymes of various kinds. The survivability of live yeast in chicken intestine is well
55 established.

56 *Saccharomyces cerevisiae* is considered one of the live microorganisms that when
57 **administered** through the digestive tract have a positive impact on the host health through its
58 direct nutritional effects (Patterson and Burkholder, 2003). Yeast boosts immune level
59 resulting in a better protection against infections (Panda *et al.*, 2000). The benefits of
60 *Saccharomyces cerevisiae* to the immune system and on coccidial infection have been
61 reported by Gao *et al.* (2008). Likewise, Jeannine *et al.* (2012) and Silva *et al.* (2012) had
62 reported its beneficial effect on Newcastle disease.

63 *Sccharomyces cerevisiae* has unidentified growth factor or unidentified growth ('plus') factor
64 (Paryard and Mahmoudi, 2008). Yeast could therefore be a performance enhancer through
65 improvement in protein utilization and a significant retention of crude fibre, thus confirms
66 yeast as possessing the ability to degrade fibrous materials in poultry feeds. Ordinarily,
67 poultry lack the enzymes (cellulases, hemi-cellulases and xylanases) to digest high fibre
68 diets (Oyedeji, 2008). A number of researches has been conducted using enriched-yeast in

69 livestock (Downs *et al.*, 2011) and in poultry, non-enriched yeast has been used (Ezema,
70 2009) and in fish (Aghdamshahnar *et al.*, 2006). Pelicia *et al.*(2010) also reported that
71 fermented yeast extracts are rich in mannan-oligosaccharides, β -glucans and other
72 nutritional metabolites that may optimize gut health and immunity, which translates to better
73 growth performance and lower risks of disease-borne pathogens. Glucans extracted from
74 *Saccharomyces cerevisiae* (baker's yeast) is one such type and is an important structural
75 element of the yeast cell wall. Yeast glucans are polysaccharides composed of smaller units
76 linked together by β -1,3 bonds. These bonds hold the glucan molecule together, hence the
77 name, β -1,3 glucan. The mode of action of β -1,3 glucan is that there is a specific receptor for
78 β -1,3 glucan on the surface of macrophages that when activated, stimulates a cascade of
79 events turning the body into "an arsenal of defense". There is now evidence to show that
80 glucan is, from an evolutionary point of view, the most widely and commonly observed
81 macrophage activator in nature and is proven to overcome the negative effects of
82 immunosuppression (FISON, 2013).

83 This study was conducted using non-enriched (Angel white label^R) yeast to investigate the
84 effect of yeast (*Saccharomyces cerevisiae*) as feed and water additive on the performance
85 of broiler chickens.

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88 **Materials and Method**

89 This study was carried out in the Teaching and Research Farm of Michael Okpara University
90 of Agriculture Umudike, Nigeria using 450 Anak broiler chicks of mixed sexes as Nigeria
91 does not sale broiler birds as separate sexes. Graded levels (0.5g kg⁻¹/l⁻¹, 1.0g kg⁻¹/l⁻¹, 1.5g
92 kg⁻¹/l⁻¹ and 2.0g kg⁻¹/l⁻¹ of feed and drinking water given *ad libitum* only by day to chicks and
93 through the finisher phase. The treatments were replicated thrice with 30 chicks per
94 replicate. Performance parameters weighted and recorded daily were daily feed intake and
95 daily weight gain. Daily protein intake (%CP * Daily feed intake), feed conversion ratio (Feed
96 intake/Weight gain), protein efficiency ratio (Daily weight gain/Daily protein intake) were

97 calculation and recorded while mortality was by counting. Diets were formulated using Excel
 98 feed formulation and feeding models (Onwurah, 2011). Proximate chemical analysis of diets
 99 were conducted using the methods of the Association of Official Analytical Chemists (AOAC,
 100 2000). All data were analyzed using Analysis of Variance (Steel and Torrie, 1980) and
 101 means separated using Duncan's Multiple Range test (Duncan, 1955) using Statistical
 102 Package for Social Sciences (SPSS,2006).

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Table 3.1: Starter and fisher diets compositions

INGREDIENTS (%)	BROILER STARTER	BROILER FINISHER
MAIZE (%)	50.00	50.00
SOYBEAN (%)	33.00	28.00
PALM KERNEL CAKE(%)	14.00	18.00
BONE MEAL(%)	3.00	3.00
SODIUM CHLORIDE(%)	0.25	0.25
TOTAL (%)	100.00	100.00
CALCULATED ANALYSIS		
CRUDE PROTEIN (%)	22.04	20.56
ME/MJ/KG	14.45	14.67

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This is with the protein and energy level as recommended (Oluyemi and
 Robberts, 2000).

Table 3.2: Proximate chemical analysis of Starter and finisher diets

INGREDIENTS	BROILER STARTER	BROILER FINISHER
CRUDE PROTEIN (%)	22.15	20.1
ETHER EXTRACT (%)	3.8	4.5
ASH (%)	7.51	7
CRUDE FIBRE (%)	3.8	5
NITROGEN FREE EXTRACT (%)	52.74	54.4
METABOLISABLE ENERGY(MJ/KG)	14.45	14.67

Vitamin/mineral premix supplying Vitamin A (1500 IU), Vitamin D3 (1600 IU), Riboflavin (9.0mg), Biotin (0.25mg), Pantothenic acid (11.0mg), Vitamin K (3.0mg), Vitamin B2 (2.5mg), Vitamin B6 (0.3mg), Vitamin B12 (8.0mg), Nicotinic acid (8.0mg), Iron (5mg), Selenium (0.01mg), Magnesium (10.0mg), Zinc (4.5mg) and Cobalt (0.02mg) / Kg

Results and Discussion

Table 4.1 Effect of yeast inclusion in feed on the performance of broiler finisher

Parameters	0.0g	0.5g	1.0g	1.5g	2.0g	SEM
Initial live weight (g)	538.89 ^b	615.05 ^a	613.67 ^a	607.00 ^a	613.89 ^a	10.10
Final live weight (g)	1957.66 ^b	2184.67 ^a	2297.33 ^a	2174.33 ^a	2270.33 ^a	36.91
Daily weight gain (g)	50.67 ^b	56.06 ^{ab}	60.13 ^a	55.97 ^{ab}	56.06 ^{ab}	1.14
Daily feed intake (g)	112.29 ^b	118.08 ^{ab}	127.18 ^a	123.52 ^{ab}	117.4 ^{ab}	2.01
Feed conversion ratio	2.23	2.11	2.12	2.20	1.99	0.04
Daily protein intake (g)	22.57 ^b	23.73 ^{ab}	25.56 ^a	24.83 ^{ab}	23.60 ^{ab}	0.04
Protein efficiency ratio	2.25	2.38	2.36	2.25	2.52	0.05
Mortality	0.00	0.00	0.00	0.00	0.00	0.00

a,b, Means within the same rows with the same superscripts not significantly (P>0.05) different. SEM = Standard error of mean.

All finisher broilers that had yeast supplementation in feed had significantly (P<0.05) higher daily weight gain and final live weight than those not

supplemented (the control) group as shown in Table 4.1. Daily live weight gain was similar in the birds that had 0.5g and 1.5g; and in those had 1.0g and 2.0g yeast inclusion in feed but highest in 1.0g yeast inclusion group. Daily feed intake and protein efficiency ratio followed the same pattern with significantly ($P<0.05$) higher feed intake recorded by birds fed 1.0g yeast in feed than those supplemented with 0.5g, 1.5g and 2.0g yeast and the control.. No significant ($P>0.05$) difference existed between birds fed 0g, 1.0g, 1.5g and 2.0g yeast in feed efficiency ratio, protein efficiency ratio and mortality. Daily protein intake was of the same pattern with daily feed intake where the 1.0g yeast had the highest protein intake.

The improved performance could be attributed to beta-glucans which has growth promoting and immune-enhancing effects in broiler chickens (Park *et al.*, 2001). This could also be attributed to carry-over effect of yeast supplementation at the starter phase. These results agree with Ghasemi (2006), who reported significant improvement in body weight gain and feed conversion ratio in chicks fed live yeast (Sc47) and Raju *et al.* (2006), who reported that up to 200mg of yeast per kg diet improved feed efficiency of broilers; as the final weights of the starter birds affected the finisher phase.

Table 4.2 Performance of finisher birds fed graded level of yeast in water

Parameters	0.0g	0.5g	1.0g	1.5g	2.0g	SEM
Initial Liveweight(g)	538.89 ^b	611.11 ^a	594.44 ^{ab}	583.33 ^{ab}	547.22 ^b	10.26
Final Liveweight(g)	1957.0 ^b	2182.66 ^a	2152.33 ^a	1986.00 ^b	1906.67 ^b	33.53
Daily Weight Gain (g)	50.67 ^{abc}	56.13 ^a	55.64 ^{ab}	50.10 ^{bc}	48.55 ^c	1.04
Daily Feed Intake(g)	114.54 ^c	123.30 ^a	120.64 ^{ab}	116.00 ^{bc}	116.17 ^{bc}	1.03
Feed Conversion Ratio	2.27	2.20	2.17	2.32	2.39	0.04
Daily Protein Intake (g)	23.02 ^c	24.78 ^a	24.25 ^{ab}	23.32 ^{bc}	23.35 ^{bc}	0.21
Protein Efficiency Ratio	2.20	2.26	2.30	2.15	2.08	0.04

Mortality	0.00	0.00	0.00	0.00	0.00	0.00
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a,b,c: Means within the same rows with the same superscripts are not significantly (P>0.05) different. SEM = Standard error of mean.

The performance of finisher broilers fed graded levels of yeast in drinking water is presented in Table 4.2. Broilers fed 0.5g yeast in water had significantly (P<0.05) higher daily weight gain , daily feed intake and final and live weight than those fed 0g, 1.5g and 2.0g yeast in drinking water. Daily protein intake also followed exactly the same pattern with daily feed intake while there were no significant (P>0.05) differences among the finisher broilers fed graded levels of yeast in feed conversion ratio and protein efficiency ratio.

This could also be attributed to the effect of oligosaccharides in yeast that enhances gut health with improved performance. This result also agrees with Park *et al.*(2001), who reported that diets with supplemental *Saccharomyces cerevisiae* at 0.025, 0.05 and 0.1% contain beta-glucans which has growth promoting and immune-enhancing effects in broiler chickens.

Table 4.3 Effect of yeast inclusion in feed/water on the performance of broiler finishers

Parameters	0.0g	0.5g	1.0g	1.5g	2.0g	SEM
Initial live weight (g)	538.89 ^a	462.38 ^b	430.50 ^b	420.23 ^b	423.36 ^b	5.76
Final live weight (g)	1957.66 ^b	1908.85 ^c	2006.62 ^a	1966.37 ^{ab}	1956.41 ^b	22.81
Daily live weight gain(g)	50.67	51.66	56.29	55.22	54.75	0.82
Daily feed intake (g)	132.29	130.06	138.37	135.11	135.87	1.53

Feed conversion ratio	2.59	2.52	2.46	2.46	2.48	0.03
Daily protein intake (g)	26.71	26.14	27.81	27.16	27.31	0.31
Protein efficiency ratio	1.92	1.99	2.02	2.03	2.01	0.03
Mortality	0.00	0.00	0.00	0.00	0.00	0.00

a,b, Means within the same rows with the same superscripts are not significantly (P>0.05) SEM = Standard error of mean.

The performance of finisher broilers fed yeast supplementation in feed/drinking water is presented in Table 4.3. Broilers fed 1.0g yeast in water had significantly (P<0.05) higher final live weight than those supplemented with 0g, 0.5, 1.5g and 2.0g yeast in feed/drinking water. The yeast treated groups of 1.5g and 2.0g were statistically different from the control and those that received 0.5g yeast. Daily live weight gain, Daily feed intake, feed conversion ratio, Daily protein intake, protein efficiency ratio and mortality were not significant (P>0.05) differences among the finisher broilers supplemented yeast inclusion levels in drinking water.

This report disagrees also with Adejumo *et al.* (2005), who reported that yeast supplementation at the starter phase is more effective for promoting feed conversion and body weight gain than that applied at the finisher phase of broiler production.

Table 4.4: Interaction between route of administration and level of yeast inclusion on broiler finisher performance

Parameter	Route	0g	0.5g	1.0g	1.5g	2.0g	Mean
Final live weight gain (g)	Water	1957.67 ^b	2297.33 ^a	2270.33 ^a	2182.67 ^a	1986.00 ^b	2138.8
	Feed	2184.67 ^a	2174.33 ^a	1957.00 ^b	2152.3 ^{ab}	1906.67 ^b	2074.9
	Mean	2071.17	2235.83	2113.67	2167.49	1946.34	
	SEM	= 27.73	R=20.54;	L=32.47;	RXL =	45.93	
Daily live weight gain (g)	Water	50.67 ^{bcd}	60.13 ^a	59.16 ^a	56.13 ^{ab}	50.10 ^{cd}	55.24
	Feed	56.06 ^{ab}	56.97 ^{ab}	50.67 ^{bcd}	55.64 ^{abc}	48.55 ^d	53.58
	Mean	53.37	58.55	54.92	55.89	49.33	
	SEM	=0.85 ;	R =0.80;	L= 1.27;	RXL =	1.80	
Daily feed	Water	112.29 ^d	127.18 ^a	117.40 ^{bc}	123.30 ^{ab}	116.00 ^{bc}	119.23

intake (g)	Feed	118.07 ^{abc}	123.52 ^{ab}	114.54 ^{bc}	120.64 ^{abc}	116.17 ^{bc}	118.59
	Mean	115.18	125.35	115.97	121.97	116.09	
	SEM	=1.12;	R =1.30;	L= 2.05;	RXL =	2.91	
Feed conversion ratio	Water	2.23 ^{ab}	2.12 ^{ab}	1.99 ^b	2.20 ^{ab}	2.32 ^a	2.17
	Feed	2.11 ^{ab}	2.21 ^{ab}	2.27 ^{ab}	2.17 ^{ab}	2.39 ^a	2.23
	Mean	2.17	2.17	2.13	2.19	2.36	
	SEM	=0.03	R =0.04;	L=0.06 ;	RXL =	0.09	
Daily protein intake (g)	Water	22.57 ^c	25.56 ^a	23.60 ^{bc}	24.78 ^{ab}	23.34 ^{bc}	23.97
	Feed	23.73 ^{abc}	24.83 ^{ab}	23.02 ^{bc}	24.25 ^{abc}	23.35 ^{bc}	23.84
	Mean	23.15	25.20	23.32	25.52	23.34	
	SEM	= 0.22;	R =0.26;	L= 0.41;	RXL =	0.58	
Protein efficiency ratio	Water	2.25 ^{ab}	2.36 ^{ab}	2.52 ^a	2.26 ^{ab}	2.15 ^b	2.31
	Feed	2.38 ^{ab}	2.25 ^{ab}	2.20 ^{ab}	2.30 ^{ab}	2.08 ^b	2.24
	Mean	2.32	2.31	2.36	2.28	2.12	
	SEM	= 0.03;	R =0.04;	L=0.07 ;	RXL =	0.10	

abcd Means on the same row with the same superscripts are not significantly (P>0.05) different.

SEM = Standard error of mean: R = Route of application: L = Level of application.

RXL = Interaction SEM.

Interaction between route and level of yeast application in broiler water and feed is presented in Table 4.0. There was no interaction in all the performance parameters studied due to application of yeast in water and in feed. This results could be attributed to no additive effect due to the simultaneous application of yeast in water and feed. This could be attributed to excess alcohol production due to excess yeast intake. This agrees with (Chem*4570) which reported that yeast provides a better solution to the problem of recycling NADH, through the enzyme *pyruvate decarboxylase* (A). This converts pyruvate to acetaldehyde by releasing CO₂, which is a non-acidic product. Acetaldehyde can then be reduced to ethanol by *alcohol dehydrogenase* (B), which consumes NADH and releases NAD⁺ so that glycolysis can continue.

Results also agree with Gheisari and Kholeghipour (n.d), who reported that both granular and powdery forms of live yeast have no growth stimulatory effects in

207 male broiler. This result disagrees with the reports of Raju *et al.*(2006), who
208 reported that up to 200mg of yeast per kg diet improved feed efficiency of broilers.

209 Conclusion

210 Birds that were supplemented yeast in feed had better performance than those
211 with supplementation in water. Yeast in water and feed had no interaction and no
212 additive effect. This study recommends the inclusion of 1.0g baker's yeast in feed
213 at the finisher phase.

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215 References

216 Adejumo DO, Onifade AA, Olutunde TO, Babatunde GM. The effects of
217 concentration, age and duration of feeding supplemental yeast (Levucel SB) in a
218 higher fibre diet on the performance of broiler chickens. J. Sus. Trop. Agric.Res.
219 2005; 13: 58-65.

220

221 Aghdamshahriar H, Nazer-Adl K, Ahmadzadeh. The effect of yeast
222 (*Saccharomyces cerevisiae*) in replacement with fish meal and poultry by-product
223 protein in broiler diets. Islamic Azad University, Iran. (2006).

224 Association of Official Analytical Chemists 2000. Official methods of analysis, 17th
225 edition. Association of OfficialAnalytical Chemists, Arlington, VA, USA.

226 Babatunde BB, Hamat RA. Effect of feeding graded levels of kolanut husk meal on
227 the performance of cockerels. Nigerian Journal of Animal Production. 2005; (32)
228 1:61-66.

229 Chem*4570 Applied Biochemistry Lecture 2 - Production of ethanol by yeast. Available
230 on line.

231 Downs KM, Hess JB, Bilgili SF. Selenium source effect on broiler carcass
232 characteristics, meat quality and drip loss. J. Appl. Anim. Research. 2012; 18, 61–
233 72. DOI:101080/09712119.2000.9706324.

234 Duncan DB. (1955). Multiple range and multiple F-test. Biometrics II: 1-42.

235 Ezema C, Ezejimbe CC, Eze DC, Kamalu TN. Effect of probiotic (*Saccharomyces*
 236 *cerevisiae*) on digestibility and growth rate of pullets fed Palm Kernel Cake based
 237 diet. A paper presented at the 34th Annual Conference of the Nigerian Society of
 238 Animal Production at the University of Uyo, Nigeria. 2009; 344-346.
 239 FISON/WINROCK workshop, Abuja. Nigeria. 2013.
 240 Gao J, Zang HJ, Yu SH, Wu SG, Yoon JQ, Gao, YP, Qi GH. Effects of yeast
 241 culture in broiler diets on performance and immunomodulatory functions. Poult.
 242 Science. 2008; 87: 1377-1384.
 243 Ghasemi HA, Tahmasbi GH, Moghaddam M, Mehri S, Alijani E, Kashefi E, Fasihi
 244 A. The effect of phytase and *Sachharomyces cerevisiae* (Sc47) supplementation
 245 on performance, serum parameters, phosphorous and calcium retention of broiler
 246 chickens. International Journal of Poultry Science. 2006; 5 (2): 162-168.
 247 Gheisari AA, Kholeghipour B. Effect of dietary inclusion of live yeast
 248 (*Sachharomyces cerevisiae*) on growth performance, immune response and blood
 249 parameters of broiler chickens. Azad university, Iran. (n.d).
 250 Ibiyo LM, Atteh JU. Response of starter broilers to diets containing graded levels
 251 of rice bran with or without palm oil. Nigerian Journal of Animal production. 2005;
 252 (32)1:39-45.
 253 Jeannine PG, Wooley RE, Emmett BJ, Dickson JA. Viricidal effect of
 254 *Lactobaccillus* and Yeast fermentation. American Society for Microbiology.
 255 Available on-line at <http://intl.aem.ams.org>; 2012.
 256 National Livestock Research Institute (2007). Use of yeast to reduce antibiotic use
 257 in broiler raising. Food and Technology Administration Centre. Retrieved from
 258 mhtml:file:\\User\\ONWURAH\\Desktop\\Document\\use of yeast to reduce anti...
 259 Oluyemi JA, Robert FA. Poultry production in warm wet climates. 4th ed. Nigeria
 260 MacMillian Press Ltd; 2000.

261 Onwurah FB. Excel feed formulation and feeding models. Indian J. of Education
 262 and Information Management.2011;1(2):88-92.
 263 Available: <http://www.iseeadyar.org/ijeim.html>
 264

265 Panda AK, Reddy MR, Rama RV, Raju MV, Paraharaj NK. Growth, carcass
 266 characteristics, immunocompetence and response to Escherichia coli of broiler fed
 267 diets with various levels of probiotics. Archives fur Geflugelkunde. 2000; 64: 152-
 268 156.

269 Park CW, Grimes JL, Ferket PR, Fairchild AS. The effects of
 270 mannanoligosachharides, bambarmycins, and virginamycins on performance of
 271 large white male market turkeys. Poult. Science. 2001; 80: 718-723.

272 Patterson JA, Bulkholder KM. Application of prebiotics and probiotics in poultry
 273 production. Poult. Science. 2003; 82: 627-631.

274 Pelicia VC, Sartori JR, Zavarize KC, Pezzato AA, Stradiotti AC, Araujo PC, Mituo
 275 MA, Madeira LA. Effect of nucleotides on broiler performance and carcass yield.
 276 Brazilian Journal of Poultry Science. 2010;12 (1): 31-34.

277 Raju MV, Reddy VR, Rama SV, Panda AK. Yeast: A multifunctional feed
 278 supplement for poultry. A review of benefits of yeast in poultry diets. Poult.
 279 International. 2006; 45: 16-21.

280 Shen YB, Piao XS, Kim SW, Wang L, Liu P, Yoon I, Zhen YG. Effects of yeast
 281 culture supplementation on growth performance, intestinal health, and immune
 282 response of nursery pigs¹. J. Anim. Science. 2009;87:2614-262