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Evaluation of Effective Microorganisms on Production Performance of Rhode Island Red Chicks

M. Simeamelak [α], D. Solomon [σ] & T. Taye [ρ]

Abstract - Effective Micro-organism (EM) is a product characterized by a mix of aerobic and anaerobic microorganisms and reported to have successfully be used for increasing productivity in integrated animal units and poultry farms in many countries including South Africa. The objective of this study was to evaluate the effect of EM on the production performance of Rhode Island Red (RIR) chicks. A total of 348 RIR day old chicks were randomly divided into twelve groups of 29 chicks each and each group was housed in separate individual pen thoroughly cleaned and prepared in advance. Finally 4 treatments containing 0, 4, 8 and 12 ml of EM/litre of drinking water were randomly assigned to the experimental chicks in completely randomized design with 3 replicates for study period of 12 weeks. Feed consumption, chick growth, feed conversion efficiency and survival rate were used as evaluation parameters. The results showed that there was no significant difference between all the treatment groups ($P>0.05$) in mean weekly feed consumption though the groups placed on the treatment containing 0 ml/liter of water tended to consume more. There was no significant difference ($P>0.05$) between all the treatment groups in growth performance during the first 4 week of brooding. However, the mean survival rate (90%) and mean weakly body weight gain to an age of 8 weeks were significantly higher for the groups assigned to the treatment containing 12 ml of EM/liter of drinking water ($P<0.05$) as compared to the others. The groups placed on the treatments containing 4-12 ml of EM/liter of drinking water showed significantly ($P<0.05$) higher feed conversion efficiency than the groups assigned to the negative control treatment. In summary the result of this study clearly showed that inclusion of 4-12ml of EM/liter of drinking water resulted in significant improvement in growth performance, feed conversion efficiency and health status during the brooding period of RIR chicks. Investigating into the feasibility of extending EM technology to indigenous chicks could be the future direction of research.

Keywords : effective microorganisms, growth performance, RIR chicks, survival rate.

I. Introduction

In the central highland of Ethiopia, almost every rural family owns chickens indicating that chickens are the most widespread and affordable source of animal protein and family income (Tadelle et al., 2003). However, there is no exact figure representing the Ethiopian poultry population. According to CACC (2003) and FAO (2005) the Ethiopian indigenous chickens are estimated at 42.9 and 39 million, respectively while the Central Statistical Authority (2004-2005) reported 31 million for both indigenous and commercial chickens. The imported chickens are estimated to be about 2.18% of the total national chicken population of the country and consist of significant proportion of Rhode Island Red (RIR) breeds of chickens. The national chick (0-8 weeks of age) population is estimated to be about 42% of the total chicken population and characterized by high mortality of about of 40–60% and periodic devastation by disease (Reference). Moreover the productivity of the indigenous chicks is low, while the survival rate of the exotic chicks are poor at the rural household levels. It have been seen that the provision of vaccination and better health care, improved feeding and the use of Effective Microorganism improve the production performance of the both indigenous and exotic chicks.(Teketel, 1986 and Abebe, 1992, Chantsawang and Watcharangkul 1999 and Konoplya and Higa 2000)

The concept of Effective Microorganisms (EM) was developed by Professor Teruo Higa, University of the Ryukyus, Okinawa, Japan (Higa, 1991; Higa and Wididana, 1991) and the first solution of EM developed contained over 80 microbial species isolated from Okinawa and other environments in Japan. The original EM technology was gradually refined to be a mix of aerobic and anaerobic microorganisms consisting of photosynthetic bacteria, lactobacillus bacteria and yeasts and/or fungi (Higa and Wididana 2007).At present EM is produced in many countries and found to be safe, effective and environmentally friendly (Sangakkara, 2001). Effective Micro-organism is found to be useful in a wide variety of fields. Studies conducted in Asia (Chantsawang and Watcharangkul 1999) and Belarus (Konoplya and Higa 2000) reported the successful use of EM in poultry feeding. The improvement in production performance of poultry fed on the ration containing EM was reported to be attributed to the improvement in feed bioavailability, balance of gastrointestinal microorganisms, and enhancement of the immunity status of the birds. It was reported to be successfully used for increasing

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productivity in integrated animal units and poultry farms in South Africa (Hanekon *et al.*, 2001, Safalaoh and Smith, 2001). There is no environmental and public health hazard reported from the use of EM technology in animal feeding (SCD, 2010 citing Kitazato Environmental Science Center, 1994). These being the cases, the objective of this research project were to evaluate the effect of Effective Micro Organisium on the production performance of Rhode Island Red chicks.

II. Methodology

a) Description of the Experimental Site

This experiment was conducted at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM), located at 357 km southwest of Addis Ababa at an altitude of 1710 meter above sea level.The mean maximum and minimum temperature of the study area is 26.8^{0}C and 11.4^{0}C, respectively and the mean maximum and minimum relative humidity is 91.4% and 39.92% respectively. The mean annual rainfall of the area is 1500mm (BPEDORS, 2000).

b) Experimental Treatments

Adequate quantities of extended/secondary EM packed in plastic jar was obtained from Weljijie P.L.C. located in Debre Zeit which intern located at 70 km east of Addis Ababa. Weljijie P.L.C. obtains the primary culture from EMROSA P.L.C. found in Sweden. The EM was transported to JUCAVM poultry farm and stored properly until required for the formulation to the experimental treatments. Four experimental treatments shown in (Table1) were prepared by inclusion of 0, 4, 8 and 12 ml of EM solution/liter of chlorine free drinking water.

c) Management of Experimental Birds

A total of 350 unsexed day old chicks of Red Island Red (RIR) breed were purchased from Southern Regional State poultry breeding and multiplication canter located in Bonga, 108 km South of Jimma town. Three hundred forty eight chicks were divided into 12 groups of 29 chicks each. Each group was housed in a separate individual pens (JUCAVM brooder house) thoroughly cleaned and well prepared in advance. Each group was randomly assigned to the four treatments in completely randomized design with 3 replicates for a study period of 12 weeks (Table 1). All the treatment groups were fed to appetite with commercial starters ration and clean water was made available all the times. Data on body weight gain, feed consumption, feed conversion ratio, survival rate and related parameters were collected throughout the study period of 12 weeks., Body weight was measured every week whereas; feed intake was measured daily. Mortality and disease conditions were recorded as occurred.

Table 1 : Treatment Allocation to the Experimental Chicks.

Treatments	Rep/Treat.	Chicks/Rep	Total
0 ml of EM/liter of drinking water, control (T1)	3	29	87
4 ml of EM/liter of drinking water (T2)	3	29	87
8ml of EM/liter of drinking water (T3)	3	29	87
12ml of EM/liter of drinking water (T4)	3	29	87
Total	12	116	348

III. Statistical Analysis

Collected data on non-random repeated measurement (body weight, Body weight gain, feed consumption and feed conversion efficiency) were subjected to Repeated Measures Design (RMD) of SAS 9.00 version for analysis (SAS institute, 2002). Least square mean were used for comparison.

IV. Results

a) Feed Consumption

The mean weekly feed consumption of the experimental chicks placed on different levels of EM are shown in Table 2. There was no statistically significant ($P>0.05$) difference between all the treatment groups in mean weekly feed consumption during the entire brooding period (Table 2). The mean weekly feed consumption of the experimental chicks was calculated to be 269.8, 260.3 260.00 and 259.4 gm/head for the treatment groups placed on the treatment containing 0, 4, 8 and 12 ml of EM/liter of drinking water respectively indicating that the groups placed on the control treatment (T_1) tended to consume more.

Table 2 : Weekly mean feed consumption (gm/head) of the experimental chicks placed on different levels of Effective Microorganisms.

Age	T_1	T_2	T_3	T_4	s.e.	p-value
Week 1	32.67	33.27	34.7	33.8	2.50	>0.05
Week 2	61.47	56.83	60.50	60.67	0.75	>0.05
Week 3	93.10	91.70	92.63	101.50	1.99	>0.05
Week 4	148.37	143.83	141.43	160.17	4.10	>0.05
Week 5	182.00	174.33	186.00	177.00	2.15	>0.05
Week 6	235.00	225.20	222.57	227.03	8.18	>0.05
Week 7	249.87	231.30	240.10	245.77	5.77	>0.05
Week 8	329.40	305.53	309.90	325.37	9.92	>0.05
Week 9	399.60	392.67	398.13	384.67	11.17	>0.05
Week 10	460.87	437.43	439.77	436.40	11.12	>0.05
Week 11	501.60	500.00	483.77	449.97	13.00	>0.05
Week 12	543.20	530.00	510.53	510.87	14.44	>0.05

**s.e. = standard-error; Means in a row without superscripts are statistically not significant (p>0.05); T_1 = control, T_2 = 4ml of EM/lit of water, T_3 = 8ml of EM/lit of water; T_4 = 12ml of EM/lit of water.*

b) Growth performance

As shown in Table 3, there was no statistically significant (P>0.05) difference in growth performance between all the treatment groups during the first four weeks of brooding. The groups placed on the treatment containing 12 ml of EM/liter of drinking water was found to be superior to all the others in mean weekly body weight gain to an age of 12 weeks, followed by the groups placed on the treatment containing 8 ml of EM/liter drinking water. On the other side the groups placed on the control treatment (T_1) was significantly lower (P<0.05) than all the others in mean weekly body weight gain to an age of 12 weeks indicating that the administration of 4-12 ml of EM/liter of drinking water resulted in better growth performance of the experimental chicks as measured by the mean weekly body weight gain.

Table 3 : Weekly mean body weight gain of the experimental chicks placed on different levels of Effective Micro organisms (gm/head).

Age	T_1	T_2	T_3	T_4	s.e.	p-value
Week 1	5.87	6.2	6.3	8.0	0.47	>0.05
Week 2	25.50	28.27	27.17	32.2	1.50	>0.05
Week 3	53.70	57.23	56.07	62.27	2.18	>0.05
Week 4	113.17	129.23	132.63	153.00	11.61	>0.05
Week 5	152.93^{b}	181.17^{b}	187.93^{b}	209.53^{a}	11.24	<.0001
Week 6	211.83^{b}	241.97^{ab}	252.57^{ab}	266.00^{a}	6.31	<0.01
Week 7	266.70^{b}	287.60^{ab}	308.67^{ab}	318.30^{a}	7.50	<0.05
Week 8	344.67	368.60	377.80	385.13	10.38	>0.05
Week 9	391.67^{b}	407.87^{ab}	401.93^{ab}	462.20^{a}	10.71	<0.05
Week 10	425.47^{b}	458.77^{ab}	510.82^{a}	534.58^{a}	11.85	<0.05
Week 11	458.83^{b}	504.58^{ab}	576.7^{a}	589.72^{a}	12.50	<0.0001
Week 12	517.10^{b}	567.13^{ab}	619.2^{a}	639.05^{a}	7.96	<0.0001
Average	247.29^{d}	269.05^{c}	288.15^{b}	305.02^{a}	3.96	<0.05

**s.e. = standard-error; Means in a row having similar superscripts are statistically not significant (p>0.05); T_1 = control, T_2 = 4ml of EM/lit of water, T_3 = 8ml of EM/lit of water; T_4 = 12ml of EM/lit of water.*

The mean weekly growth performance of females and males were separately recorded during the 9^{th} – 12^{th} weeks of the feeding period (Table 4). There was no statistically significant difference (P>0.05) between all the female treatment groups in body weight gain during the 9^{th}-12^{th} weeks of feeding, though the groups placed on the treatment containing 8 ml of EM/liter of drinking water tended to be higher than the others.

Table 4 : Weekly body weight gain of females placed on different levels of EM (gm/head).

Age	T_1	T_2	T_3	T_4	s.e.	p-value
Week 9	50.87	51.00	52.56	50.23	14.63	>0.05
Week 10	108.40	110.47	139.30	150.40	16.77	>0.05
Week 11	139.93	143.83	214.10	194.70	15.34	>0.05
Week 12	197.37	209.50	261.37	248.93	16.72	>0.05
Average	124.14	128.70	166.83	161.07	8.70	>0.05

**s.e. = standard-error; Means in a row without superscripts are statistically not significant (p>0.05); T_1 = control, T_2 = 4ml of EM/lit of water, T_3 = 8ml of EM/lit of water; T_4 = 12ml of EM/lit of water.*

The mean weekly body weight gain of the groups of males receiving 8-12 ml of EM/liter of drinking was significantly (p<0.05) higher than the others indicating that males are more reactive to administration EM in drinking water than the females as measured in terms of weekly body weight gain. There was no significant difference (P>0.05) between the groups of males placed on the treatment containing 0 ml and 4 ml of EM/liter of drinking water in weekly body weight gain during the 9th-12th weeks of feeding.

Table 5 : Weekly body weight gain of cockerels placed on different level of EM (gm/head).

Age	T_1	T_2	T_3	T_4	s.e.	p-value
Week 9	51.03	67.53	73.00	62.20	14.88	>0.05
Week 10	115.20^{b}	118.60^{ab}	155.73^{ab}	173.53^{a}	15.56	<0.005
Week 11	141.73^{b}	166.87^{ab}	212.70^{a}	229.50^{a}	15.17	<0.05
Week 12	210.83^{b}	236.30^{ab}	250.43^{ab}	273.93^{a}	16.66	<0.05
Average	129.70^{b}	147.33^{ab}	172.97^{a}	184.79^{a}	12.02	<0.05

**s.e. = standard-error; Means in a row having similar superscripts are statistically not significant (p>0.05); T_1 = control, T_2 = 4ml of EM/lit of water, T_3 = 8ml of EM/lit of water; T_4 = 12ml of EM/lit of water.*

c) Feed Conversion Efficiency

The results of feed conversion ratio of the experimental chicks placed on the different treatments are shown in Table 6. There was no statistically significant (p>0.05) difference between all the treatment groups in feed conversion ratio expressed as grams of feed consumed /gram body weight gained during the brooding period. The treatment groups receiving 12 ml of EM/liter of water showed significantly better (p<0.0001) feed conversion ability than the others during the first week of brooding. However, there was improvement in feed conversion ratio as a result of addition of 4-12 ml of EM/liter of drinking water as compared to the control group. Statistically significant (P<0.01) difference in feed conversion ratio appeared starting from the 10th week of the feeding trial (Table 6). Significantly larger amount of feed was consumed per unite body weight gain brought by the groups (p<0.05) assigned to the control treatment (0 ml of EM/liter of water)indicating that there was improvement in feed conversion efficiency as a result of inclusion of 4-12 ml of EM/liter of drinking water starting from the 10th week keeping.The mean weekly feed conversion ratio brought by the groups assigned to the treatment containing 0 ml/liter of drinking water was significantly (P<0.001) higher than all the others.

Table 6 : Weekly feed conversion ratio of chicks placed on different levels of EM (gm of feed /gm body weight gain).

Age	T_1	T_2	T_3	T_4	s.e.	p-value
Week 1	5.64^{a}	5.49^{a}	5.84^{a}	4.23^{b}	0.68	<0.0001
Week 2	3.75	3.20	3.51	2.93	0.22	>0.05
Week 3	3.50	3.19	3.35	3.15	0.13	>0.05
Week 4	2.39	2.54	2.52	2.35	0.31	>0.05
Week 5	3.35	2.77	2.77	2.55	0.22	>0.05
Week 6	3.57	3.00	2.93	2.85	0.12	>0.05
Week 7	3.76	3.33	3.17	3.16	0.12	>0.05
Week 8	3.87	3.52	3.41	3.46	0.07	>0.05
Week 9	4.43	4.06	4.20	3.71	0.14	>0.05
Week 10	5.18^{a}	4.57^{b}	4.16^{b}	4.03^{b}	0.14	<0.0001
Week 11	5.92^{a}	5.14^{ab}	4.53^{b}	4.41^{b}	0.19	<0.01
Week 12	6.28^{a}	5.51^{ab}	5.04^{b}	4.87^{b}	0.16	<0.0001
Average	4.35^{a}	3.86^{b}	3.78^{b}	3.48^{c}	0.13	<0.001

**s.e. = standard-error; Means in a row having similar superscripts are statistically not significant (p>0.05); T_1 = control, T_2 = 4ml of EM/lit of water, T_3 = 8ml of EM/lit of water; T_4 = 12ml of EM/lit of water.*

d) Rate of Survival

About 90% of the experimental chicks assigned to the treatment containing 12 ml of EM/liter of drinking water survived to an age of 4 weeks, the value of which is higher than all the others. The highest survival rate to an age 8 weeks was recorded from male chicks receiving treatment containing 12 ml/liter of water (Table 7).

Table 7 : Mean weekly survival rate of experimental chicks placed on different level of Effective Microorganisms.

Age	T_1	T_2	T_3	T_4
Week 4	82.76	87.36	87.36	89.66
Week 8	75.86	86.21	87.36	87.36
Week 8 females	73.56	93.1	82.76	66.67
Week 8 males	78.27	71.74	84.79	94.21

Cost benefit analysis (table 8) showed both T_2 and T_3 had positive net return over the control, while T_4 was showed negative return over the control.

Table 8 : Partial budget analysis on different level of Effective Microorganisms (currency in Ethiopian Birr, ETB).

Trt/parameters	T1	T2	T3	T4
Total cost/T	637.49	700.48	714.07	736.49
Total income/T	1213.33	1423.33	1350.00	1233.33
Net return/T	575.85	722.85	635.93	496.84
Net return over the control	-	147.00	60.08	-79.01

**Total cost = cost of birds, feed, EM, labor water and electric*

**Total income = sale of birds and eggs*

V. Discussion

a) Feed Consumption

The mean weekly feed consumption to an age of 12 weeks was calculated to be 269.76, 260.25, 260.00 and 259.43 gm/head for the groups assigned to the treatment containing 0 ,4, 8 and 12 ml of EM/liter of drinking water respectively indicating that the groups placed on the control treatment tended to consume more. In line with this results Safalaoh (2006), reported that groups of broilers fed diets supplemented with EM, at the rate of 1ml/liter of drinking water had lower feed consumption compared to the groups fed on control treatment. The current results are also in agreement with that of Santoso et al. (2001) who reported that inclusion of 0.5% fermented product of *Bacillus subtilis* reduced feed consumption of the experimental chicks. A trial conducted by Botlhoko (2009) to study the effect of EM, AGP (antimicrobial growth promoter) and combination of EM and AGP at the rate of 50 ml/ per liter of water showed that feed consumption to an age of 21 days was higher for the groups of broilers fed on the control treatment. Feed additives usually play roles by regulating feed intake and increasing digestibility of nutrients and energy (Wenk, 2000). On the contrary, the results of this study disagree with that of Ashraf, et al. (2005), who reported higher feed consumption from groups of broilers supplemented with mixture of probitic microbs as compared to those placed on the negative control treatment. Similarly in an attempts made to study the effect of probitic (Bio-Plus 2B®) on broilers both during growing and finishing periods. Rahimi (2009) reported that the supplemented groups tended to consume more than the groups placed on the control treatment.

b) Growth Performance

The treatment groups placed on the control treatment was significantly lower ($P<0.05$) than all the others in mean weekly body weight gain to an age of 12 weeks indicating that the administration of EM in drinking water resulted in better growth performance of the experimental chicks. This result is in agreement with that of Wenk (2000), who reported that feed additives usually play rolls by regulating feed intake and increasing digestibility of nutrients and availability of energy. The results of this study showed that there was no significant difference between the groups placed on the treatment containing 8-12 ml of EM/liter of drinking water in mean in weekly mean body weight gain to an age of 12 weeks. These results are in agreement with that of Kalavathy et al., (2003) who reported improved body weight gain of broiler with supplementary administration of Lactobacillus. Rahimi (2009) also reported significantly higher ($P<0.05$) body weight gain of broilers placed on a probitic (Bio-Plus 2B®) organisms both during growing and finishing periods. Similarly Safalaoh (2006) reported, significantly ($P < 0.05$) higher body weight gain from experimental broilers fed diets supplemented with EM, at the rate of 1ml/liter of water.

c) Feed Conversion Efficiency

The amount of feed consumed per unite body weight gain was significantly ($p<0.05$) higher for the

groups receiving control treatment indicating that there was improvement in feed conversion efficiency as a result of inclusion of 4-12 ml of EM/liter of drinking water. There was no significant ($P>0.05$) difference in feed conversion ratio between the groups receiving 4 and 8 ml of EM/liter of drinking water. These results are in agreement with that of (Kalavathy et al., 2003) who reported improved feed conversion ratio of broiler offered supplementary administration of Lactobacillus. Rahimi (2009) also reported significantly better ($P<0.05$) feed conversion ratio of broilers placed on a probitic (Bio-Plus 2B®) organisms during the last phase of the finishing period. He reported significantly better feed conversion ratio from the groups of broilers placed on a probitic (Bio-Plus 2B®) organisms during the first three weeks of rearing.

d) Rate of survival

About 90% of the experimental chicks assigned to the treatment containing 12 ml of EM/liter of drinking water survived to an age of 4 weeks, the value of which is higher than all the others. The highest survival rate was recorded from male chicks placed on 12 ml of EM/liter of water to an age of 8 weeks. On the contrary significantly lower survival rate was recorded from the group paced on the control treatment. This result agrees with the report which indicated that inclusion of live microorganisms in feed or water in adequate amounts confers a health benefit on the host animals (Wenk, 2000). The results of a survey conducted by Hoyle (1992) on small scale poultry keeping in Welaita, North Omo region also indicated that the most challenging period for indigenous chicks kept under natural brooding condition in Ethiopia is from is 2 to 4 weeks after hatching (Solomon, 2007). There has been no mortality recorded from all the treatment groups starting from the 9th week of the experimental period showing that all the mortality recorded occurred during the first 8 weeks of brooding. The majority of the death recorded during the first 8 weeks of brooding was attributed to sticking of feces on anus and mechanical damage.

The result of this study is similar to that of Jin et al (1998), who reported improved survival rate of chicks with the administration of EM. He reported reduction in mortality of the experimental chicks from 8.2% to 3.2% as a result of administration of EM. Timmerman *et al.* (2006) showed marked decrease in mortality after EM administration. According to Barrow (1992),the absence of normal micro flora in the cecum of poultry has been considered as a major factor in the susceptibility of chicks to bacterial infection. Hanekon *et al.* (2001) and Safalaoh and Smith (2001) reported that EM was successfully used for increasing survival rate in integrated animal units and poultry farms in South Africa. Improvement in health status of the birds seems to be attributed to the colonization of chicken intestinal tract by lactic acid bacteria which controls the population of pathogenic microorganisms such as Salmonella, Enterococci and E. coli spp, Edens *et al.* (1997). Cost benefit analysis (Table 7) seems to agree with that of Dahal (1999) who reported that the use of EM (either in water or feed) in broiler production was found to be safe and profitable. He reported higher profit per bird from the use of EM in water as compared to the use of EM in feed due to additional cost of bokashi preparation.

VI. Conclusion

The result of this study showed that EM could improve production performance of RIR chicks. Even though, the three EM treatment levels (4ml, 8ml, and 12ml) showed their own merits to improve overall performance of RIR growers, based on key parameters treating chickens with different rate of EM based on their age is recommendable.

Since T_4 showed highest feed conversion ability for the first week and high percent survival between day-old to four weeks age, 12ml of EM/lit of chlorine free water (or spring or dug well water) is recommendable for this age group. Due to lack of significant difference for the EM treated groups (T_2, T_3 and T_4) between four and eight week age 4ml of EM would be economical for this age groups in a chlorine free (or spring or dug well water). Since there was insignificant survival difference between all treatment groups (T_1, T_2, T_3 and T_4) after eight week it is economical to terminate EM provision for chicks. Due to lack of difference in survival rate after eight week of growth and insignificant feed intake, feed conversion efficiency and age at maturity, treating pullets after 8weeks could not be economically feasible due to unreasonable EM cost.

References Références Referencias

1. Abebe Hassen 1992. Terminal report on the comparative evaluation of native chicken and their crosses with the single comb White Leghorn in the Hararge Administrative Region.
2. Ashraf, M., M. Siddique, S.U. Rahman, M. Arshad and H.A. Khan, 2005. Effect of Various Microorganisms Culture Feeding AgainstSalmonella Infection in Broiler Chicks. *J. Agri. Soc. Sci., Vol. 1, No. 1, 2005.*
3. Barrow, P. 1992. Probiotic for chickens. Pages 225–257 in Probiotics, the Scientific Basis. R. Fuller, ed. Chapman and Hall, London.
4. Botlhoko, T.D., 2009. Performance of clostidium prifringes-challenged broilers inoculated with effective microorganisms. An MSc thesis submitted in partial fulfillment of the requirement for the degree of MSc, department of Animal and Wild life, faculty of Natural and agricultural science. University of Pretoria.
5. BPEDORS, 2000. Physical and socio economical profile of 180 District of Oromia Region. Bureau of Planning and Economic Development of Oromia

Regional state, Physical planning Development. Finfinne, Ethiopia. 248-251p.
6. Central Agricultural Census Commission (CACC), 2003. Statistical report on farm management practices, livestock and farm managements.
7. Chantsawang, S and Watcharangkul, P. 1999. Influence of EM on quality of poultry production. In Proceedings of the 5th International Conference on Kyusei Nature Farming, Thailand, 1998 Senanayake, Y D A and Sangakkara U R (Ed) APNAN, Thailand: 133 – 150.
8. Dahal, B. k. 1999. Effective microorganisms for animal production. Institute of agriculture and animal science.
9. Edens, F.W., Parkhurst, C.R., Casas, I.A., Dobrogosz, W.J., 1997. Principles of ex ovo competitive exclusion and in ovo administration of Lactobacillus reuteri. Poultry Science. Savoy, IL: Poultry Science Association, Inc. Jan 1997. 76: l79-196.
10. FAO (Food and Agriculture Organization of the United Nations). 2005. Livestock sector brief: Ethiopia.FAO. Livestock information, sector analysis and policy branch AGAL. 2004. Rome.
11. Hanekon D, Prinsloo, J F and Schoonbee, H. J. 2001. A comparison of the effect of anolyte and EM on the faecal bacterial loads in the water and on fish produced in pig cum fish integrated production units. In Proceedings of the 6th International Conference on Kyusei Nature Farming, South Africa, 1999 Senanayake, Y D A and Sangakkara U R (Ed) (In Press)
12. Higa, T and G.N. Wididana, 2007. The Concept and theory of Effective Microorganism.
13. Hoyle, E., 1992. Small-scale poultry keeping in Welaita, North Omo region. Technical pamphlet No. 3 Farmers Research Project (FRP). Farm Africa Addis Ababa.
14. Jin, L. Z., Y. W. Ho, N. Abdullah, and S. Jalaludin. 1998. Growth performance, intestinal microbial populations, and serum cholesterol of broilers fed diets containing *Lactobacillus* cultures. *Poult. Sci.* 77:1259–1265.
15. Kalavathy, R., Abdullah, N., Jalaludin, S., and Ho, Y. W., 2003. Br. Poultry Sci., 44: 139-144
16. Konoplya, E F and Higa, T. 2000. EM application in animal husbandry – Poultry farming and its action mechanisms. Paper presented at the International Conference on EM Technology and Nature Farming, October 2000, Pyongyang, DPR Korea.
17. Meseret, Molla, D. Solomon and D. Tadelle, 2011. Marketing System, Socio Economic Role and Intra Household Dynamics of Indigenous Chicken in Gomma Wereda, Jimma Zone, Ethiopia. *Livestock research for rural development 23 (6)2011*
18. Rahimi, M, 2009. Effects of probiotic supplementation on performance and humoral immune response of broiler chickens Book of Proceedings, 2nd Mediterraean Summit of WPSA.
19. Rynsburge, Joni M., 2009. Physiological and nutritional factors affecting protein digestion in broilers chicken. An MSc Thesis Submitted to the College of Graduate Studies and Research, University of Saskatchewan, Saskatoon, SK, Canada.
20. Safalaoh, A. C. L and Smith, G A 2001. Effective Microorganisms (EM) as an alternative to antibiotics in broiler diets: Effects on broiler performance, feed utilization and serum cholesterol. In Proceedings of the 6th International Conference on Kyusei Nature Farming, South Africa, 1999 Senanayake, Y D A and Sangakkara U R (Ed) (In Press).
21. Safalaoh, A. C. L, 2006. Body weight gain, dressing percentage, abdominal fat and serum cholesterol of broilers supplemented with a microbial preparation. *African Journal of Food Agriculture Nutrition and Development,* **6**(1)
22. Santoso, O. U. K; TAnake, K.; Ohtani, S. and Sakaida, M., 2001. Asian-Aust. J. Anim. Sci., 14: 333-337.
23. Shiferaw Mulugeta 2006. Survey and Rectification of the Causes of Poor Fertility and Hatchability of Eggs from Rhode Island Red (RIR) Chicken Breeds in Ethiopia. Alemaya University, Ethiopia.
24. Solomon Demeke, 2007. Suitability of homemade hay-box chick brooder to the Ethiopian household poultry production system. *Livestock Research for Rural Development. Volume 19, Article#3*
25. SAS Institute Inc, 2002. Statistical analysis Software version 9.00, Cary, NC: SAS Institute Inc.USA.
26. SCD (Sustainable Community Development, LLC). 2010. Efficient Microbes (EM) Applied Science and SCD Probiotics Evaluated for Poultry Production. SCD Probiotics 1327 E 9th Street Kansas City, MO 64106 www.SCDProbiotics.com.
27. Tadelle Dessie., Million, T., Alemu, Y. and Peters, K.J., 2003. Village chicken production systems in Ethiopia: Use pattern and performance valuation and chicken products and socioeconomic functions of chicken. *Livest. Res. Rural Dev.* 15(1).
28. Teketel Forsido 1986 Studies on the meat production potential of some local strains of chicken in Ethiopia. PhD Thesis. J.L. University of Giessen, pp 210.
29. Timmerman H. M., A. Veldman, E. van den Elsen, F. M. Rombouts and A. C. Beynen, 2006. Mortality and Growth Performance of Broilers Given Drinking Water Supplemented with Chicken-Specific Probiotics. *Poult Sci 2006.* 85:1383-1388.
30. Wenk, C., 2000. Recent advance in animal feed additives shuch as metabolic modifiers, antimicrobial agents, probiotics, enzymes and highly available minerals. *Asia-Aus J. Anim. Sci.2000 Vol.13 no.186:95.*