



TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY



FINAL REPORT

of the
EXTERNAL FUNDED RESEARCH PROJECT ON

INFLUENCE OF STRUCTURED WATER ON THE PERFORMANCE OF BROILERS

SPONSORED BY
VWF Industries Pvt. Ltd.,
90, K.R.S. Road, Metagalli, Mysore - 570 016.

IMPLEMENTED BY
Department of Animal Nutrition,
Veterinary College and Research Institute, Namakkal – 637 002.

2014

TAMILNADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY

Madhavaram Milk Colony, Chennai - 600 051, INDIA.

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To

M/s. VMF Industries Private Ltd.,
90, K.R.S. Road,
Metagalli,
Mysore – 570 016.

Sir,

Sub: TANUVAS – VMF Industries Private Ltd., - Project on “**Influence of structured water on the performance of broilers**” – Final Report
– Sending – Regarding.

* * * * *

I am forwarding three copies of the Final Report of the project on “**Influence of structured water on the performance of broilers**” received from Dr. P.Vasantha kumar, PI and Professor, Department of Animal Nutrition, Veterinary College and Research Institute, Namakkal – 637 002 for your kind perusal.

Yours faithfully,

Encl: As above

K. Kumanan
17.10.14

DIRECTOR OF RESEARCH,
TANUVAS, CHENNAI – 51

**TAMIL NADU VETERINARY AND
ANIMAL SCIENCES UNIVERSITY**



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RESEARCH PROJECT ON**

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2014

TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY


**Department of Animal Nutrition,
Veterinary College and Research Institute, Namakkal – 637 002.**


CERTIFICATE

Certified that the research project entitled “Influence of structured water on the performance of broiler chicken” was carried out at the Department of Animal Nutrition, Veterinary College and Research Institute, Namakkal – 637 002 during May – September, 2014 which was sponsored by VWF Industries Pvt. Ltd., 90, K.R.S. Road, Metagalli, Mysore - 570 016.


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(D. Chandrasekaran)**


**Principal Investigator
(P. VASANTHAKUMAR)**


**Head of the Department
PROFESSOR AND HEAD
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PROJECT PARTICULARS

Title of the project	:	INFLUENCE OF STRUCTURED WATER ON THE PERFORMANCE OF BROILERS
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Funding agency		VWF Industries P Ltd., 90, K.R.S. Road, Metagalli, Mysore - 570 016.
Budget		Rs. 2.20 lakhs
Period and Duration		From May, 2014 to October, 2014 Six months
University Sanction Order		U.S.O.No: 50058/G2/2014 and Proc.No: 6884/G2/2014 dated 30.04.2014 of the Registrar, TANUVAS, Chennai-600 051.
Head of Account		Unit No: XXIII – Other agency Scheme on “Influence of structured water on the performance of broilers” – Department of Animal Nutrition, VC& RI, Namakkal – 637 002, Tamil Nadu. Scheme Code No: 23193.
Institutional Animal Ethics Committee Approval		Lr.No:1981/E3/IAEC/Edn.Cell/2014 dated 27.05.2014 of the Dean, VC&RI, Namakkal.

ABSTRACT

Open and bore well water are commonly used as drinking water in majority of the poultry farms in India. When the drinking water is passed through specially designed apparatus in which tuned geometry creates an energy environment for the water to structure itself, it gives the water a lower surface tension and better hydrating properties. This geometric technology breaks up large low energy water molecule clusters into smaller high energy clusters and results in high solubility of minerals and vitamins. In order to study the influence of structured water on the performance of commercial broiler chicken, an experiment was conducted using 216 numbers of Vencobb chicks up to 42 days of age. The birds were assigned to two groups comprising of nine replicates per group with 12 birds per replicate. The control group (n=108) was offered tap water whereas the treatment group was offered structured water for drinking purpose. The body weight (g) was numerically higher in structured water group (2016 ± 28 vs 1989 ± 26) as compared to tap water offered group. Similarly, the feed conversion efficiency was relatively better (1.769 ± 0.02 vs 1.802 ± 0.02) in structured water group as compared to the tap water offered group. The total quantity of water consumed (ml/bird) up to six weeks age was less ($P < 0.05$) in structured water group (11511 ± 144) as compared to the tap water (11101 ± 112) offered group. The feed cost per kg body weight gain was low (Rs.1.03) in structured water group (Rs. 54.88 ± 0.55 vs 55.91 ± 0.48). From this study, it can be inferred that structured water offered to commercial broiler chicken for drinking purpose resulted in extra profit of Rs.2.06 per bird.

1. INTRODUCTION

Quality of drinking water influences the performance of commercial chicken. Source of water is one of the important factors affecting water quality. Mountain spring water and river water are generally considered to be good for health. However, open and bore well water are commonly used in majority of the poultry farms. Nowadays attempts are made to modify the properties and qualities of drinking water for improving the performance and health of livestock and poultry. When the drinking water is passed through specially designed apparatus in which tuned geometry creates an energy environment for the water to structure itself. This gives the water, a lower surface tension and better hydrating properties. This geometric technology breaks up large low energy water molecule clusters into smaller high energy clusters. It has a high solubility for the minerals and vitamins, which are formed with structured water, tend to go from the digestive tract and bloodstream into the tissues. Structured water can be formed using lights, magnets, temperature changes, (quartz crystals, pyramids and sounds. Recently, M/s VWF Industries Pvt. Ltd., 90, K.R.S. Road, Metagalli, Mysore - 570 016 has developed and marketing a new apparatus for the production of structure altered water for livestock and poultry production. Hence, this project was proposed to evaluate the performance of commercial broilers offered structured water.

2. OBJECTIVES

1. To study the properties of structured water.
2. To study the influence of structured water on the performance of commercial broiler chicken.
3. To study the cost effectiveness.

3. MATERIALS AND METHODS:

The physical and chemical properties of structured water were compared with tap water used as drinking water in the poultry house. The physical and chemical properties of structured water such as p^H , conductivity, salinity, TDS were recorded periodically.

Biological trail

A broiler trial using a total of 216 commercial broiler chicks was conducted for a period of six weeks. The chicks were divided into 2 treatment groups, each group with 12 replicates and each replicate having 9 birds. The birds belonging to control

group (n=108) were offered tap water whereas the treatment group was offered structured water for drinking purpose.

Group	Experimental groups	No. of birds
TW	100 % tap water offered as drinking water	108
SW	100 % structured water offered as drinking water	108
	TOTAL	216

Body weight of all the birds was recorded at the time of grouping on first day. The other parameters were recorded periodically throughout the experimental period (up to 42 days)

1. Body weight (weekly)
2. Feed intake (weekly)
3. Water consumption (daily)

The feed conversion efficiency was worked out for different phases of growth. The litter moisture levels were estimated at the end of the experiment.

Slaughter Studies

At the end of the experimental period, a total of 48 birds at the rate of 24 birds from each group (@ two birds from each replicate) were slaughtered to study the carcass quality. The total length of the intestine was measured and expressed as cm per kg body weight.

Mineral solubility and retention studies

The *in-vitro* solubility of macro minerals such as calcium and phosphorus were tested using tap water and structured water. One gram of sample of di-calcium phosphate was taken in a 250 ml beaker and 150 ml of 0.5 % citric acid solution prepared from either tap water or structured water or distilled water was added. The solution was mixed well at 30-40 rpm using a magnetic stirrer for one hour. Then the volume was made up to 250 ml using distilled water. The solution was filtered through Whatman No: 1 filter paper and the solubility of calcium and phosphorus were calculated.

The amount of retention of minerals was determined by conducting a metabolic trial. A total of ten birds from each group were randomly selected and subjected to metabolic trial for a period of seven days. The feces excreted by all the birds were collected for three days consecutively and subjected to nitrogen, calcium, phosphorus, copper, manganese and zinc analysis. The quantity of feed consumed by the birds was

measured individually and the feed samples were analyzed for nitrogen, calcium, phosphorus, copper, manganese and zinc contents so as to calculate the retention of minerals.

Table 1 Ingredient and chemical composition (%) of broiler rations

Feed ingredients	Pre-starter	Starter	Finisher
Maize	55.00	57.00	59.00
Soyabean meal	38.00	35.00	31.00
Salt	0.29	0.30	0.311
Calcite	1.60	1.03	1.000
Di-calcium phosphate (DCP)	1.15	1.81	1.599
Rice bran oil	2.61	4.33	6.038
Additives (%)			
NSP degrading enzyme	0.05	0.05	0.04
Phytase-2500	0.02	0.01	0.01
DL-Methionine	0.30	0.30	0.26
Lysine	0.28	0.17	0.16
Threonine	0.03	0.03	0.16
Sodium bicarbonate	0.25	0.20	0.19
Broiler mineral premix (Trouw)	0.15	0.15	0.15
Broiler vitamin premix	0.04	0.04	0.04
US Curatox	0.05	0.05	0.05
Oxy 100 FS	0.05	0.05	0.05
Coxistac	0.05	0.05	0.05
Anti oxidant (Endoxdry)	0.01	0.01	0.01
Vitamin E 50 %	0.005	0.005	0.010
Lysoforte	0.10	0.10	0.10
Choline chloride (60%)	0.15	0.15	0.15
Hepatocare	0.10	0.10	0.10
Grand Total	100.00	100.00	100.00
Chemical composition			
Dry matter (%)	89.82	89.29	90.98
Crude protein (%)	23.31	21.00	19.35
Crude fibre (%)	3.24	3.00	2.51
Ether extract (%)	5.23	6.35	8.81
Total ash (%)	6.87	6.35	6.21
Nitrogen free extract (%)	51.17	53.29	53.09
Calcium (%)	1.05	1.00	1.05
Total phosphorus (%)	0.66	0.61	0.62
Metabolisable Energy (kcal/kg) (calculated)	2900	3100	3200

4. RESULTS AND DISCUSSION

The observations recorded during the study are interpreted and presented in this chapter.

4.1 Properties of structured water

The properties such as p^H , conductivity, TDS and salinity of tap water as well as structured water were recorded daily during the experimental period using handheld portable water analysis unit and the data are given in Table 2.

Table 2. Properties of structured water

Attribute	Tap water	Structured water
p^H	8.13 ± 0.01	8.05 ± 0.01
Conductivity (μs)	285.10 ± 1.37	282.41 ± 1.51
TDS (ppm)	206.49 ± 1.27	204.77 ± 1.31
Salinity (ppm)	124.79 ± 0.69	123.54 ± 0.77
Temperature ($^{\circ}C$)	31.00 ± 0.11	30.81 ± 0.10

Each value is mean of 39 observations

There was no significant difference between tap water and structured water. Since no chemical process is involved in the apparatus during preparation of structured water, probably changes in p^H , conductivity, TDS and salinity were not observed in this study.

4.2 Production performance of broiler chicken.

Body weight of birds, feed intake, water consumption and feed conversion ratio recorded for different phases of growth are presented in Table 3. The body weight (g) was numerically higher in structured water group (2016 ± 28 vs 1989 ± 26) as compared to tap water offered group. Similarly, the feed conversion efficiency was relatively better (1.769 ± 0.02 vs 1.802 ± 0.02) in structured water group. The body weight, feed intake and FCR recorded at weekly intervals (Table 4) up to six weeks of age did not differ significantly. However, the total quantity of water consumed (ml/bird) up to 42 days of age was less ($P < 0.05$) in structured water offered group (11511 ± 144) as compared to the tap water (11101 ± 112) offered group.

Table 3 Influence of drinking structured water on the production performance of broiler chicken during 0-42 days of age

ATTRIBUTE	Pre-starter phase (0 - 14 days)	Starter phase (15 – 28 days)	Finisher phase (29 – 42 days)	Overall (0 - 42 days)
Cumulative body weight gain (g)				
Tap water	270 ± 2	805 ± 10	914 ± 18	1989 ± 26
Structured water	272 ± 2	816 ± 10	928 ± 23	2016 ± 28
Cumulative feed intake (g)				
Tap water	393 ± 6	1463 ^b ± 6	1726 ± 28	3582 ± 29
Structured water	407 ± 5	1435 ^a ± 5	1721 ± 27	3564 ± 27
Feed conversion efficiency (FCR)				
Tap water	1.458 ± 0.011	1.821 ± 0.025	1.895 ± 0.023	1.802 ± 0.016
Structured water	1.496 ± 0.026	1.765 ± 0.027	1.868 ± 0.035	1.769 ± 0.018
Cumulative water consumption (ml/bird)				
Tap water	1292 ± 23	4424 ± 55	5794 ^b ± 104	11511 ^b ± 144
Structured water	1270 ± 17	4358 ± 47	5473 ^a ± 67	11101 ^a ± 112

Body weight gain : Each value is mean of 108 observations

Feed intake, feed efficiency ratio and water intake: Each value is mean of 12 observations.

Means with different superscript in a column differ significantly ($p \leq 0.05$)

Table 4 Influence of drinking structured water on the performance of broiler chicken (week wise)

Treatments	1 st week	2 nd week	3 rd week	4 th week	5 th week	6 th week
Cumulative body weight (g) (n=108)						
Tap water	136±0.7	321±4	632±4	1126±10	1492±12	2041±21
Structured water	137±1	325±3	636±4	1140±15	1497±19	2068±24
Cumulative feed intake (g/bird) (n=12)						
Tap water	101±4	393±6	881±7	1856±6	2529±15	3582±29
Structured water	108±4	407±5	889±7	1842±6	2524±14	3564±27
Feed conversion ratio (n=12)						
Tap water	0.743±0.027	1.223±0.010	1.571±0.008	1.650±0.015	1.696±0.011	1.757±0.015
Structured water	0.785±0.024	1.253±0.021	1.572±0.009	1.619±0.019	1.689±0.016	1.725±0.017

Body weight gain : Each value is mean of 108 observations

Feed intake, feed efficiency ratio and water intake: Each value is mean of 12 observations.

Means with different superscript in a column differ significantly ($p \leq 0.05$)

4.3 Slaughter studies

The data related to slaughter studies are given in Table 5. Dressing percentage and weights of skin plus feather, blood, liver, gizzard, thymus, bursa, feet and head did not vary significantly between the two groups. The heart and spleen weights were significantly ($P<0.05$) high and abdominal fat content was low ($P<0.05$) in structured water group as compared to tap water offered group. Though statistically not significant, the intestinal length was relatively more and litter moisture content was less in structured water group. However, the immune status of birds assessed in terms of titre value against Ranikhet Disease during 6th week of age revealed that the titre value was high ($P<0.05$) in structured water offered group as compared to tap water offered group.

Table 5 Influence of structured water on carcass traits, weights of organs, immunity and litter moisture (%) at 42 days of age.

Attribute	Tap water	Structured water
Skin + feather weight (as BW %)	12.27 ± 0.31	12.51 ± 0.36
Blood weight (as BW %)	3.35 ± 0.14	3.54 ± 0.13
Liver weight (as BW %)	2.06 ± 0.05	2.08 ± 0.05
Heart weight (as BW %)	9.16 ^a ± 0.20	10.12 ^b ± 0.34
Gizzard weight (as BW %)	1.84 ± 0.04	1.99 ± 0.06
Dressing percentage	65.20 ± 1.23	67.61 ± 0.56
Thymus (as BW %)	0.256 ± 0.027	0.294 ± 0.019
Spleen weight (as BW %)	1.817 ^a ± 0.005	2.730 ^b ± 0.012
Bursa weight (as BW %)	0.072 ± 0.008	0.099 ± 0.010
Abdominal fat (as BW %)	1.204 ^b ± 0.061	1.021 ^a ± 0.055
Feet weight (as BW %)	4.06 ± 0.11	4.19 ± 0.09
Head weight (as BW %)	3.26 ± 0.05	3.34 ± 0.09
Intestinal length (cm/kg BW)	96.42 ± 1.879	101.66 ± 1.587
Hot carcass weight (g)	1355.46 ± 21.98	1361.67 ± 14.63
RD titre value (log ₂)	3.39 ^a ± 0.08	4.11 ^b ± 0.32
Litter moisture (%)	11.51 ± 0.94	10.92 ± 0.96

Each value is mean of 24 observations (except litter moisture in which n=12)
Means with different superscript in a row differ significantly ($p\leq 0.05$)

4.4 Minerals solubility and retention

The *in-vitro* solubility of minerals in citric acid (0.5 %) solution and retention of minerals by the birds are given in Tables 6 and 7.

Table 6. *In-vitro* solubility of calcium and phosphorus in 0.5 % citric acid solution

Attribute	Distilled water	Tap water	Structured water
Calcium solubility (%)	89.7±2.76	85.3±2.91	86.1±2.52
Phosphorus solubility (%)	75.60±2.31	71.43±2.31	72.06±2.47

The 0.5 % citric acid solutions were prepared using either distilled / tap or structured water

Each value is mean of 4 observations

Calcium and phosphorus source used is di-calcium phosphate containing 25.2 % Ca and 15.6% P

Table 7. Nutrient digestibility and retention of minerals as influenced by drinking structured water in commercial broilers

	Treatment group	DM (g)	Nitrogen (g)	Ca (g)	P (g)	Cu (ppm)	Zn (ppm)	Mn (ppm)
Intake (per bird per day)	TW	110.24±3.16	3.54±0.10	1.13±0.03	0.69±0.01	4.23±0.12	15.04±0.43	14.59±0.41
	SW	109.23±2.45	3.51±0.79	1.13±0.02	0.69±0.01	4.15±0.09	14.94±0.33	14.48±0.32
Out go (per bird per day)	TW	31.83±1.15	1.16±0.07	0.59±0.03	0.35±0.01	3.09±0.11	9.80±0.80	12.26±0.79
	SW	31.97±1.37	1.17±0.05	0.57±0.05	0.34±0.02	3.11±0.12	9.89±0.67	12.09±0.43
Digested / retained (per bird per day)	TW	78.41±4.16	2.38±0.60	0.54±0.01	0.34±0.01	1.14±0.03	5.24±0.13	2.33±0.11
	SW	77.26±4.45	2.34±0.64	0.56±0.01	0.35±0.01	1.04±0.04	5.05±0.15	2.39±0.12
Digestibility / retention (%)	TW	71.06±2.55	67.23±2.23	47.80±2.11	49.28±2.61	26.95±1.81	34.84±1.83	15.97±0.76
	SW	70.73±2.76	66.67±2.59	49.56±2.05	50.72±2.46	25.06±1.74	33.80±1.90	16.51±0.71

TW – Tap water SW – Structured water Each value is mean of 10 observations

The *in-vitro* solubility of calcium and phosphorus in 0.5 % citric acid solution did not vary significantly. However, the solubility of both Ca and P were relatively low in tap / structured water as compared to the distilled water probably due to high pH (8.03). Similarly, the digestibility of nutrients and retention of minerals are similar

among the tap and structured water offered groups which showed that utilization of minerals are not affected by the source of water used for drinking purpose.

4.5 Economics

The economics of offering structured water over tap water is presented in Table 7. The average feed cost per bird up to six weeks of age were Rs. 111.11 ± 0.90 and Rs. 110.54 ± 0.82 for tap water and structured water offered groups, respectively. The feed cost per kg live weight was low (Rs.1.03) for structured water group and the extra profit available was Rs 2.07 per bird.

Table 7 Influence of drinking structured water on the economics of commercial broiler production

Treatment	Tap water	Structured water
Feed cost (Rs.)		
Cost of pre-starter feed per kg (Rs.)	31.21	31.21
Cost of starter feed per kg (Rs.)	31.07	31.07
Cost of finisher feed per kg (Rs.)	30.93	30.93
Feed intake (g)		
Pre starter phase	393 ± 6	407 ± 5
Starter phase	1463 ± 6	1435 ± 5
Finisher phase	1726 ± 28	1721 ± 27
Cost of feeding (in Rs.) during different phases (Rs.)		
Pre starter phase	12.27 ± 0.20	12.70 ± 0.16
Starter phase	45.46 ^b ± 0.18	44.59 ^a ± 0.15
Finisher phase	53.38 ± 0.87	53.24 ± 0.84
Total feed cost (0 - 6 weeks)	111.11 ± 0.90	110.54 ± 0.82
Average weight gain (kg / bird)	1.989	2.016
Feed cost / kg body weight gain (Rs.)	55.91 ± 0.48	54.88 ± 0.55
Difference (Rs / per kg live weight)	-	+1.03
Extra profit per bird (Rs.)	-	+ 2.07

Each value is mean of 12 observations

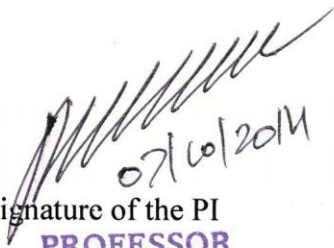
Means with different superscript in a row differ significantly ($p \leq 0.05$)

Conclusions

1. The properties such as p^H , conductivity, TDS and salinity of tap water and structured water did not vary.
2. Biological trial conducted in broilers (up to 42 days) revealed that the body weight (g) was numerically higher in structured water group (2016 ± 28 vs 1989 ± 26) as compared to tap water offered group. Similarly, the feed conversion efficiency was relatively better (1.769 ± 0.02 vs 1.802 ± 0.02) in structured water group as compared to the tap water offered group.
3. The heart and spleen weights were high ($P < 0.05$) and abdominal fat content was low ($P < 0.05$) in structured water group.
4. The immune status of birds assessed in terms of titre value against Ranikhet Disease during 6th week of age revealed that the titre value was high (4.11 ± 0.32) in structured water offered group over the tap water (3.39 ± 0.08) offered group.
5. The extra profit earned due to offering structured was Rs. 2.07 (@Rs.1.03 per kg live weight) per bird.

Place : NAMAKKAL

Date : 01.10.2014.


07/10/2014
Signature of the PI
PROFESSOR
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