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Impact of Cofee Weed (*Senna occidentalis*) Leaf Aqueous Extract as Probiotic on the Performance of Broiler Chickens in Humid Tropical Environment

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Authors' contributions

This work was carried out in collaboration between all authors. Author SOO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DOO and SEO managed the analyses of the study and the literature searches. While Authors JIU, IA and EI conducted the experiment. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To investigate the growth performance, carcass traits, organ weights, costs and returns of 120 day-old Aborican broiler chicks placed on different dosages of *Senna occidentalis* leaf aqueous extract.
Study Design: Completely randomized design (CRD) was used.
Place and duration of study: Department of Animal Science, Poultry Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Edo State of Nigeria between June and July 2017 (eight weeks).
Methodology: Twenty four chicks were randomly selected based on their average initial weights and assigned to five dosages (0, 25, 50, 75 and 100 ml) of coffee weed leaf aqueous extract (CWLAE) designated as T1, T2, T3, T4 and T5 with T1 serving as positive control. Each treatment group contained three replicates with eight birds per replicate.
Results: Data on growth performance showed that only the final live weight and daily weight gain

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were significantly (P=.05) higher in birds that had 50mls of coffee weed leaf aqueous extract and lowest in those placed on 100 mls of CWLAE at the finisher phase. Carcass traits revealed that live weight, plucked weight, eviscerated weight and dressing percentage were significantly (P=.05) higher among birds that had 50ml of CWLAE compared to other dietary treatments. The relative weights of drumstick, thighs, breast, wings, neck, back, shanks, abdominal fat, lungs, liver, heart, whole gizzard and bursa were significantly (P=.05) influenced by the treatments. The costs and returns analyses of broiler chickens revealed that cost of feed consumed and cost of feed per kilogram weight gain was lowest among birds placed on the control, but the highest income and net profit were recorded among birds placed on 50 mls of coffee weed leaf aqueous extract.

Conclusion: *Senna occidentalis* aqueous leaf extracts can be used as a probiotic additive at 50 mls / liter of water to enhance the performance, carcass traits, cost and returns of broiler chickens.

Keywords: Broilers; carcass; organs; costs and returns; coffee weed.

1. INTRODUCTION

An astronomical increase in the productivity of modern poultry stocks has been achieved for both the meat and egg production sectors of the global poultry industry in the last few decades. Synergies have resulted from advances made in all the major activities of poultry management, housing, nutrition and ration formulation, application of poultry genetics, knowledge in commercial breeding programmes and better diagnosis and control of avian diseases [1]. Amongst all these core elements, poultry health and diseases are the least predictable. In broiler production, good health accompanied with fast growth is necessary if maximum productivity is to be achieved [1]. Although high quality and adequate quantity of feed may be provided, the amount of feed digested, nutrients absorbed and utilized are very important. Generally, digestion in poultry may among other factors depend on the micro-organisms that naturally inhibit and colonize the digestive tract [2]. Thus the need to formulate diets that enhance gut health and function has become imperative. Consequently, feed additives such as antibiotics have been used for these purposes at sub-therapeutic doses in poultry diets. They act directly against pathogens in the gut creating a favourable environment for protein and energy digestion, absorption and metabolism [3]. However, birds raised with these feed additives achieve good performance but the potential side effects such as host and cross drug resistance poses a public health concern globally [4] and this has led to the ban of these products by many countries of the world [5].

Against this background, research efforts by Nutritionists have been geared towards the search for plant materials and their derivatives as natural antibiotics and probiotics in animal feeds. However, a wide range of drugs have been currently employed in the management of hepatic disorders in livestock, but alternative approaches from the traditional medical systems have been used. Up to one-third of all commercial swine and chicken rations in Europe now use mixtures of herbs and spices to accelerate growth and maintain health [6]. Some of these herbs and spices indigenous to Africa, enhance nutrient utilization and performance of broiler chickens [7,8]. The administration of aqueous extract of C*hromolena odorata* on male Wistar albino rats appears relatively safe at low levels but begin to manifest biochemical and histological evidence of toxicity at high levels [9]. Similarly, aqueous extracts of scent leaf (*Ocimum grattisimum*) administered orally could reduce oxidative and toxicant activity and enhance specific activities of hepatic oxidants in rats [10]. The anti diabetic effect of aqueous extract of *Vernonia amygdalina* (bitter leaf) and its ability to reduce both blood glucose and serum triglyceride levels is highly remarkable [11,12]. The application of aloe vera (*Aloe barbadensis*) to an open wound induces significant wound contraction and accelerates wound healing, and the aqueous extract may be a promising medication for open wounds [13]. It was also reported [14] that neem (*Azadirachta indica*) leaf meal can be included in the diets of broiler chicks up to 2.5 g/kg without any deleterious effects on their performance, serum biochemical constituents, and hematological indices. *Moringa oleifera* leaf meals have been used as alternative feeding stuff in broiler starters without any effect on their hematological profile [15]. In view of the above, the present study is focused on *Senna occidentalis* which has been found to possess significant antibacterial, antifungal and diuretic properties. The potentials of *Senna occidentalis* for the treatment of allergic and inflammatory diseases had been stressed [16]. Data on proximate composition [17] showed 10% moisture, total ash of between 7.4 and 8.0%, the acid in the soluble ash of 5.3 - 5.9%, alcohol and water extractive values of 7.7% and 15.1% respectively. While, a crude protein of 23%, crude fiber 20.8%, lipids 14.9% and carbohydrate 48.1% have been reported [18]. The phytochemical analyses of *Senna occidentalis* revealed [19] the presence of

alkaloids, anthocyanosides, phenolics, proteins, chlorobatamins, steroids, tannins, resins, basalms, amino acids, carbohydrates, sugars, and cardiac glycosides. Recently [20] 9.35, 21.88, 19.72, 16.88, 9.70 and 22.47% of moisture content, crude protein, crude fibre, crude fat, ash and nitrogen-free extract (NFE) respectively and the presence of cardiac glycosides, saponins, phenols, flavones, flavonols and alkaloids in dried *Senna occidentalis* leaf meal were reported. This study was therefore designed to investigate the effect of *S. occidentalis* leaf aqueous extract as a probiotic additive on the performance, carcass traits, organ weights, costs and returns of broiler chickens.

2. MATERIALS AND METHODS

2.1 Experimental Location and Climate

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma for a period of eight (8) weeks. The farm lies between latitude 6.44ºN and longitude 6.80ºE in Esan West Local Government Area, Ekpoma, Edo State, Nigeria. Ekpoma is within the South -South geo-political zone of Nigeria and has a prevailing tropical climate with a mean rainfall of about 1556mm. The mean ambient temperature ranges from 26ºC in December to 34ºC in February, relative humidity range from 61% in January to 92% in August with the yearly average of about 82%. The vegetation represents an interface between the tropical rainforest and derived savannah.

2.2 Sources of Feed and Fresh Coffee Weed Leaves

Commercial broiler starter and finisher diets were purchased from a reputable feed dealer in Ekpoma, Esan West Local Government Area of Edo State, Nigeria. Fresh coffee weed (*Senna occidentalis*) leaves were purchased from Ekpoma main market in Esan West Local Government Area, Edo State, Nigeria.

2.3 Processing of Coffee Weed Leaf Extract

The fresh leaves were thoroughly rinsed, dried and sparsely spread on jute mat at room temperatures of between 26ºC and 29ºC for 6 – 7 days until they became crispy. The leaves were regularly turned to avoid uneven drying and decay to ensure that the greenish color of the leaves was maintained. The dried crispy leaves were hammer milled through a 2mm sieve and stored in airtight containers to avoid the absorption of moisture till they were used for laboratory analyses and preparation of the aqueous extract. A measured quantity (50g) of the ground leaves was infused in 1litre of boiled hot water and allowed to stay overnight (12hours). After that, the solution was filtered in the morning using a clean white piece of cloth (handkerchief) and a measured quantity of the filtrate according to the experimental treatment was added to 1litre of drinking water and served to the birds.

2.4 Experimental Feeding and Treatments

The birds were fed the commercial starter and finisher diets (Table 1) with crude protein and metabolizable energy of 21 and 18%, 2900 and 2900 KCal/ kg respectively. Five (5) treatments (T_1, T_2, T_3, T_4 and T_5) were prepared to contain 0, 25, 50, 75 and 100ml of coffee weed leaf aqueous extract (CWLAE) per 1litre of drinking water and 2.5g of Centre tidox (Doxycycline and Tylosin) served as a positive control (T_1).

2.5 Experimental Birds, Design and Management

A total of 120 broiler chicks were used for the experiment. Twenty four (24) chicks were randomly selected and allocated to each of the five (5) treatment groups (T_1, T_2, T_3, T_4, and T_5) in a completely randomized design (CRD). Each treatment group contained three (3) replicates with eight (8) birds per replicate. The chicks were brooded for four (4) weeks during which they were fed with the commercial starter diet without the experimental treatments for one week acclimatization period. After that, the coffee weed leaf aqueous extract (CWLAE) was added to their drinking water at dosages of 0, 25, 50, 75 and 100ml (T_1, T_2, T_3, T_4, and T_5) for three (3) weeks at the starter phase. At the finisher phase, the chicks were fed with commercial finisher diet in addition to the treatments (T_1, T_2, T_3, T_4, and T_5). The birds were allowed free access to the commercial diets and treatments *ad libitum* throughout the duration of the study. However, the synthetic antibiotic (Doxycycline and Tylosin) as a

Table 1. Nutrient composition of the commercial starter and finisher diets

Nutrient Composition (%)	Starter	Finisher
Crude protein	21.00	18.00
Fat/Oil	6.00	6.00
Crude fibre	5.00	6.00
Calcium	1.00	1.00
Available phosphorous	0.45	0.40
Lysine	1.00	0.85
Methionine	0.60	0.30
Salt	0.30	0.30
Metabolizable energy (Kcal/kg)	2900	2900

positive control (T_1) was applied at weekly intervals. All routine management practices were carried out including vaccinations.

2.5.1 Performance study

During the feeding trial, the broiler chicks were weighed at the beginning of the experiment and subsequently on a weekly basis. Weight changes and feed consumption were recorded weekly, while weight gain, feed intake, feed conversion ratio (FCR), protein efficiency ratio (PER) were estimated to assess the growth performance of the birds. Weight gain was calculated as final weight minus initial weight and feed conversion ratio (FCR) was calculated using the formula:

$$\text{Feed Conversion Ratio} = \frac{\textit{Feed Intake (g)}}{\textit{Weight Gain (g)}}$$

2.5.2 Carcass analysis and relative organ weights

At the end of the eight weeks feeding trial, all the birds were fasted overnight, and two (2) chickens were randomly selected from each replicate making a total of 6 chickens per treatment group and a total of thirty (30) chickens in all. Each bird was tagged and weighed to determine the live weight. The slaughtered birds were dipped in hot water for about one (1) minute, and the feathers were plucked and weighed to obtain the plucked weights. The plucked chickens were eviscerated, weighed and recorded as eviscerated weights. The eviscerated weight refers to the weight of the bird being partially butchered with all the Viscera organs removed. The dressing percentage was expressed as the percentage ratio of the eviscerated weight to live weight. i.e.

Dressing percentage (%) = {(Eviscerated weight (kg) / Live weight (kg)) x (100 / 1)}

After that, the carcass was cut into parts such as head, neck, drumstick, shank, breast, back, thigh and wings and their weights recorded. The viscera organs (liver, heart, kidney, spleen, lungs, bursa, abdominal fat and gizzard) were excised, blotted free of blood and weighed. The weight of the cut parts and organs were expressed relative to the eviscerated weight as shown below:

The relative weight of cut part= {(The weight of the cut part (g) / Eviscerated weight (g)) x (100 / 1)}

Relative organ weight= {(The weight of organ (g) / Eviscerated weight (g)) x (100 / 1)}

2.5.3 Costs and returns analyses

The prevailing market prices of commercial feed, day old chicks, coffee weed leaves and the live market value of broiler chickens as at the time of the experiment (June to July, 2017) were used to estimate cost and returns.

2.6 Statistical Analysis

Data generated were subjected to a one-way analysis of variance (ANOVA), and treatment means that significantly differed were compared using the Duncan's Multiple Range Test [21,22].

3. RESULTS AND DISCUSSIONS

3.1 Growth Performance of Broiler Chickens

The performance data of birds on different dosages of coffee weed leaf (*Senna occidentalis*) aqueous extract revealed that there were no significant (P=.05) variation in

average live weight, daily weight gain, daily feed intake and feed conversion ratio at the starter phase, while at the finisher phase, average live weight and daily weight gain were significantly (P=.05) different. However, average daily feed intake and feed conversion ratio were not significantly (P=.05) affected by the various dosages of coffee weed leaf aqueous extract. The comparable daily weight gains and daily feed intake of birds across the varying dosages of coffee weed leaf aqueous extract (CWLAE) is an indication that the concentrations were within tolerable limits of the birds and hence their growth was not suppressed. This finding is in line with the report [23] that no significant differences were observed in the weight gain and feed intake of weaner rabbits fed toasted (*Senna occidentalis)* seed meal. Plant extracts such as *Senna occidentalis* leaf extract and *Telfera occidentalis* leaf extract contains low levels of saponins, tannic acid, phytate, and oxalate which are anti-nutrient substances that depress animal growth [24,25]. However, in the present study, coffee weed leaf aqueous extract did not exert any negative influence on the growth of the animals indicating that the concentration of the toxicant inherent in the leaf extract was not toxic to the animals. The lowest and best feed conversion ratio recorded among the broiler chickens that had 50mls of coffee weed leaf aqueous extract maybe attributed to the improvement in the energy and protein consumption of the birds resulting from the enhanced nutrient availability due to the coffee weed leaf aqueous extracts. The better final live weight and daily weight gain of birds that had 50mls of coffee weed leaf aqueous extract suggests that this level may have stimulated a higher digestive activity on the nutrients consumed by the birds thereby promoting greater efficiency in the utilization of feed resulting in enhanced growth which culminated into the highest final live weight. These findings are in tandem the report [26,27] that broiler chickens tolerated lower levels of *Senna occidentalis, Telfera occidentalis,* and *Gongronema latifolia* leaf extracts. The numerically lowest but best feed conversion ratio recorded among broiler chickens fed 50mls of aqueous coffee weed extract at the finisher phase could be attributed to the improvement in the energy and protein consumption of birds resulting from the enhanced nutrient availability due to coffee weed leaf aqueous extracts.

Table 2. Growth performance of broiler starter as influenced by coffee weed leaf aqueous extract

Parameters	Dosages of CWLAE (ml)					SEM±
	0	25	50	75	100	
	T_1	T_2	T_3	T_4	T_5	
Ave. live weight (g/birds)	860.00	833.33	903.33	893.33	863.33	13.12
Daily weight gain (g/bird)	33.81	32.38	36.24	33.33	30.93	3.14
Daily feed intake (g/bird)	44.63	45.13	43.90	44.22	44.73	6.52
Feed conversion ratio	1.29	1.37	1.23	1.36	1.52	1.09
Mortality (%)	0.00	0.00	0.00	0.00	0.00	-

SEM±: Standard error of mean

Table 3. Growth performance of broiler finishers as influenced by coffee weed leaf aqueous extract

Parameters	Dosages of CWLAE (ml)					SEM±
	0	25	50	75	100	
	T_1	T_2	T_3	T_4	T_5	
Ave. final live weight (kg/birds)	2.20^{b}	2.15^{c}	2.40^{a}	2.15^{c}	2.10^{d}	0.03
Daily weight gain (g/bird)	57.14^{b}	57.14^{b}	67.38^{a}	58.09^{b}	56.19^{b}	1.34
Daily feed intake (g/bird)	109.66	109.86	116.45	114.03	113.49	1.52
Feed conversion ratio	1.92	1.92	1.73	1.97	2.04	0.04
Mortality (%)	11.11	5.56	0.00	0.00	0.00	0.00

abc: Means in the same row with varying super scripts differ significantly (P=0.05), SEM±: Standard error of mean

3.2 Carcass Traits of Broiler Chickens

The data on carcass characteristics as influenced by aqueous leaf extract of *Senna occidentalis* indicated that mean live weight, plucked and eviscerated weights, dressing percentage, relative weights of drumstick, thighs, breast, wings, neck, back and shanks were significantly (P=.05) influenced by the treatments, while the relative weight of head was not significantly (P=.05) influenced by the treatments. The significantly (P=.05) higher live weight recorded among birds fed 50ml of CWLAE which translated to higher plucked weight, eviscerated weight and dressing percentage could be due to the metabolizable energy, protein, minerals and relatively low anti-nutrients [28]. The values of dressing percentage obtained in the study ranged from 79.84-86.96% and were within the reported [29,30] range of 81.68 – 84.50% for broilers fed diets that contained *Tetrepleura tetraptera.* The significant (P=.05) higher dressing percentage of birds on treatment 3 in this study is an indication that the nutrients were better and most effectively utilized by the birds with respect to digestion, absorption, and assimilation. This is in tandem with the report [31] that the inclusion of bitter leaf in broiler diets led to improvement in body weight, dressing percentage and significantly promoted higher dressed weight and carcass quality. The values for drumstick, thigh, breast, and back were significantly higher in birds that had treatments 2 and three compared to other treatments. This negates the non significant differences in the thighs, drumstick, wings, breast, and back of broiler chickens fed olive leaf extract [32]. This implies better profitability on birds placed on treatments 2 and three than others since they are the highly priced cut parts [30]. The relative weight of the head of broiler chickens was not significantly (P=.05) different amongst the treatment group and was not in harmony with an earlier report [24]. The relative weights of wings, back, neck and shanks were significantly (P=.05) higher among birds fed treatment three compared to other treatments which infer that the birds can perform better on treatment three without any adverse effect on the carcass quality.

3.3 Relative Organ Weights of Broiler Chickens

Results of the relative organ weights of broilers (Table 5) showed that the relative weights of abdominal fat, wings, liver, heart, whole gizzard and bursa were significantly (P=.05) different amongst the treatment groups. However, the relative weights of spleen and kidney were not significantly (P=.05) influenced by the treatments. This point to the fact that CWLAE did not cause any toxicity and abnormal metabolic activity in the organs or systems of the birds. The variation in the relative weights of the liver may perhaps be due to the hepato protective nature of the test ingredient [32]. Liver weight of birds placed on the control was

Table 4. Carcass characteristics of broiler chickens as influenced by coffee weed leaf aqueous extra

Parameters	Dosages of CWLAE (ml)					SEM±
	0	25	50	75	100	
	T_1	T_2	T_3	T_4	T_5	
Ave. final live weight (kg/birds)	2.20^{b}	2.15^{c}	2.40^{a}	2.15^{c}	2.10^{d}	0.03
Plucked weight (kg/bird)	2.08^{b}	1.98^{c}	2.30^{a}	1.98^{c}	1.98^{c}	0.01
Eviscerated weight (kg/bird)	1.85^{b}	1.73^{bc}	2.00^{a}	1.83^{b}	1.67^{c}	0.04
Dressing percentage (%)	84.09^{ab}	80.65^{ab}	86.96^{a}	85.30^{ab}	79.84^{b}	2.04
Cut parts (%)						
Drumsticks	12.40^{b}	14.63^{a}	12.15^{b}	13.42^{ab}	12.09^{b}	1.27
Thighs	25.12^{a}	25.01^{a}	25.98^{a}	22.16^{b}	22.60^{b}	0.56
Breast	21.75^{bc}	22.80^{b}	24.48^{a}	21.18^{c}	18.44^{d}	0.44
Wings	14.61^{ab}	15.29^{a}	14.07^{b}	13.70^{b}	15.53^{a}	0.36
Head	3.03	2.98	3.25	3.01	3.20	0.09
Neck	5.90^{bc}	5.49^{c}	6.44^{a}	5.91^{bc}	6.27^{ab}	0.16
Back	6.22^{cd}	6.09^{d}	9.76^{a}	6.89^{b}	6.61^{bc}	0.08
Shanks	4.43^{c}	5.12^{b}	5.75^{a}	5.77^{a}	5.19^{b}	0.12

abc: Means on the same row with varying superscripts differ significantly (P=.05) SEM±: Standard error of the mean

significantly (P=.05) higher than those on treatments 3, 4 and five but on par with treatment 2. The hypertrophic nature of the liver and lungs of the birds served CWLAE could be adduced to the extra work executed by the organs on the additional bulk of CWLAE. This observation corroborated [33] 2.17 – 2.57% for the liver weight of broiler chickens. Besides, the use of *Azodirachta indica* leaf extracts in broiler production exhibited better nutrient digestibility of crude protein and ether extracted coupled with improved intestinal histo-morphological parameter studies [33].

3.4 Costs and Returns Analyses of Broiler Chickens

Data on the costs and returns analyses of broiler chickens on the treatments revealed (Table 6) that cost of feed consumed, and cost of feed per kilogram weight gain was lowest among birds placed on the control. The reduction in the cost could be ascribed to the uniformity in the price of the commercial feed offered to the birds and the inclusion of the cost of CWLAE in other treatments aside from the control. This finding is accordance with the

Table 5. Relative organ weights of broiler chickens as influenced by coffee weed leaf aqueous extract

Organs (%)	Dosages of CWLAE (ml)					SEM±
	0	25	50	75	100	
	T_1	T_2	T_3	T_4	T_5	
Abdominal fat	1.60^{a}	1.65^{a}	1.24^{c}	1.28^{c}	1.42^{b}	0.03
Lungs	0.70^{c}	0.76^{b}	0.83^{a}	0.70^{c}	0.75^{bc}	0.02
Liver	2.59^{a}	2.60^{a}	2.40^{b}	2.19^{c}	2.10^{c}	0.05
Heart	0.69^{c}	0.96^{a}	0.61^{d}	0.78^{b}	0.75^{bc}	0.02
Spleen	0.02	0.03	0.02	0.02	0.01	0.01
Whole gizzard	2.93^{b}	2.89^{b}	3.20^{a}	3.22^{a}	3.38^{a}	0.08
Bursa	1.10c	1.19^{abc}	1.27^{a}	1.17^{bc}	1.25^{ab}	0.22
Kidney	0.06	0.09	0.06	0.06	0.06	0.01

abc: Means on the same row with varying superscripts differ significantly (P=.05) SEM±: Standard error of mean

Table 6. Costs and Returns Analyses of Broiler Chickens as Influenced by coffee weed leaf aqueous extract

Parameters	Dosages of CWLAE (ml)				
	0	25	50	75	100
	T_1	T_2	T_3	T_4	T_5
Starter phase					
Cost of day-old chicks (₦/bird)	180.00	180.00	180.00	180.00	180.00
Cost of feed/Kg(₦)	152.00	152.00	152.00	152.00	152.00
Cost of feed consumed (₦/bird)	189.95	192.07	186.84	188.20	190.37
Cost of feed/ kg wt gain (₦/bird)	5.14	4.92	5.51	5.07	4.70
Finisher phase					
Cost of feed/Kg (₦)	158.00	158.00	158.00	158.00	158.00
Cost of feed consumed (₦/bird)	481.54	486.03	515.18	504.47	502.08
Cost of feed/kg wt gain (₦/bird)	9.03	9.03	10.65	9.17	8.88
Total cost of feed consumed (₦/bird)	675.09	678.10	702.02	692.67	692.45
Total cost of production (₦/bird)	855.09	858.10	822.02	872.67	872.45
Income (₦/bird)	2,200	2,100	2,500	2,100	2,000
Net profit (₦ /birds)	1,344.91	1,241.90	1,617.98	1,227.33	1,127.55

report [34,35] that the highest price of feed consumed, and cost of feed per kilogram weight gain was recorded among birds fed the control diet compared to those on graded levels of boiled pigeon pea seed meal.

The highest income and net profit recorded among birds placed on 50mls of coffee weed leaf aqueous extract can be traceable to the highest live weight recorded in birds on the treatment. This further reaffirmed the earlier assertion [36] that any improvement in the feed efficiency through the use of local feed stuff reduce high production cost and consequently increase the profit margin.

4. CONCLUSION

The different dosages of *Senna occidentalis* leaf aqueous extract had no detrimental effect on the growth performance, carcass traits and internal organs. However, the best dosage concerning the growth performance, costs and returns was 50 ml/ liter of drinking water.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

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