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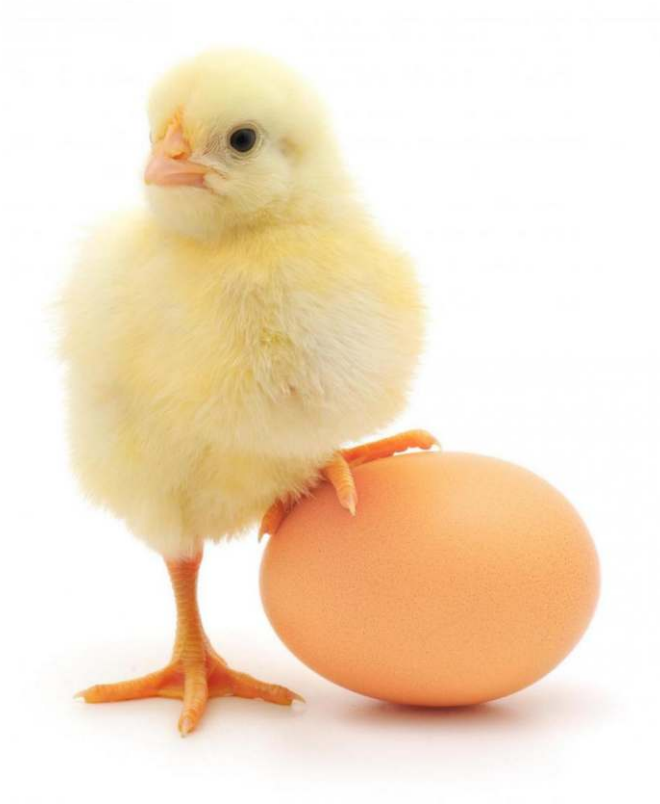

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Production Performance of Broilers Fed with *Aloe vera* and *Curcuma longa* (Turmeric)

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Abstract: An experiment was conducted to study the inclusion of *Aloe vera* and *Curcuma longa* and its combinations on production performance, viz., weight gain, feed intake and feed conversion ratio, carcass characteristics and biochemical parameters for a period of six weeks with two hundred and eighty commercial, straight run day-old Vencobb broiler chicks. These chicks were randomly grouped into seven treatments with four replicates of ten chicks each. The treatment groups consisted of control (T_1), 0.1 percent *Aloe vera* powder (T_2), 0. 2 percent *Aloe vera* powder (T_3), 0.1 percent *Curcuma longa* powder (T_4), 0.2 percent *Curcuma longa* powder (T_5) and 0.1 percent of *Aloe vera* and 0.1 percent of *Curcuma longa* powder (T_6) and 0.2 percent of *Aloe vera* and 0.2 percent of *Curcuma longa* powder (T_7) included in the broiler diet. The results revealed that there was no significant difference in body weight and body weight gain between treatment groups from first week to end of the experiment period except at first week ($P < 0.01$). Similarly, no significant difference was recorded in feed consumption and carcass yields, but in feed conversion ratio significant ($P < 0.01$) difference was recorded at first week of age. Livability was 100 percent in T_2 and T_3 treatment groups. The mean return over feed cost differs significantly ($P < 0.01$) between treatment groups up to six weeks of age, which was mainly due to difference in feed cost of *Aloe vera* and *Curcuma longa* inclusion in broiler diet.

Key words: Broiler, production performance, *aloe vera*, turmeric, feed cost

Introduction

Poultry sector in India has developed unprecedented growth during last three decades and now transformed itself into the status of an industry. Today, India ranks third largest producer in eggs (Watt Executive Guide, 2007) and fifth largest producer in broiler chicken (Watt Executive Guide, 2005) in the world. The poultry production as practiced today is a specialized one and concentrating more on the use of high performance birds. The major factors for successful poultry production are high genetic potential, balanced nutrition and health maintenance. On the other hand, there is a major demand to produce high quality poultry meat and egg at low price without rely on antibiotics and other medicines in poultry feed and water.

Aloe vera and *Curcuma longa* (Turmeric) are the two herbs are used for various functions like antibacterial, antiseptic, anti-inflammatory, nematocidal and immunomodulatory properties. Besides, usage of these herbs for medicinal preparations, it can also be included in the poultry diet as feed additive to utilize their benefits to the maximum extent. Hence, this research work was designed in broilers by including different levels of *Aloe vera*, *Curcuma longa* and their combinations to study the production performance of broilers.

Materials and Methods

Experimental design: Two hundred and eighty commercial, straight run day-old Vencobb broiler chicks belonging to single hatch were purchased from local hatchery, wing banded, weighed and randomly allotted into seven treatment groups with four replicates of ten chicks each. The chicks were reared in broiler cages in a gable roofed, open sided house. All the chicks were provided with uniform floor, feeder and waterer space and were reared under standard management conditions throughout the experimental period of six weeks.

Experimental diet: The experimental diet was formulated according to the standards prescribed in Bureau of Indian Standards (B.I.S., 1992). *Aloe vera* and *Curcuma longa* powder was included in the basal diet and the following experimental groups were formed.

Treatments	Experimental diets
T_1	Control
T_2	0.1 percent *Aloe vera* powder
T_3	0.2 percent *Aloe vera* powder
T_4	0.1 percent *Curcuma longa* powder
T_5	0.2 percent *Curcuma longa* powder
T_6	0.1 percent of *Aloe vera* and 0.1 per cent of *Curcuma longa* powder
T_7	0.2 percent of *Aloe vera* and 0.2 per cent of *Curcuma longa* powder

The broiler starter and finisher diets were fed *ad libitum* to the birds from 1-28 and 29-42 days of age, respectively.

The diets were subjected to proximate analysis as per AOAC (1995). The ingredients and nutrient composition of the experimental broiler starter and finisher diet are presented in Table 1.

Collection of data: Data on body weight, feed consumption were recorded at weekly intervals and mortality was recorded at occurrence. From the above data, body weight gain, feed efficiency and livability were calculated.

Return over feed cost: Return over feed cost of broilers reared under different inclusion levels of *Aloe vera* and *Curcuma longa* powder was worked out by using the prevailing market rates.

Statistical analysis: The data collected on various parameters were subjected to statistical analysis using Completely Randomized Design (CRD) as per the methods suggested by Snedecor and Cochran (1989). Angular transformation was applied to percentages wherever needed.

Results and Discussion

Production performance, Body weight and body weight gain: Statistical analysis of data on body weight and body weight gain revealed no significant difference among the treatment groups due to dietary inclusion of *Aloe vera* and *Curcuma longa* and its combinations. However, numerically higher body weight was observed in treatment groups (T_3, T_4, T_6 and T_7) at sixth week of age compared to control (Kumari *et al.*, 1994; Changkang *et al.*, 2007). It was consistent with Sinurat *et al.* (2002) who reported that broiler chickens fed with fresh *Aloe vera* gel (0.25 g/kg) and dry *Aloe vera* gel (0.25 and 1.0 g/kg) had no significant effect on body weight and Namagirilakshmi (2005) also stated that broiler chickens fed with turmeric at 0.25, 0.50, 0.75 and 1.00 percent levels did not significantly affect the body weight.

On the contrary, Kumar *et al.* (2005) observed a significant ($P < 0.05$) increase in weight gain in broiler chickens fed with turmeric (1 g/kg of diet) over those of the control group. Similarly, Jagadeeswaran (2007) observed that the broilers fed one percent *Aloe vera* showed significant ($P < 0.01$) difference in body weight gain at 6 weeks of age.

Feed consumption: The analysis of data on mean cumulative feed consumption revealed no significant difference between treatment groups due to dietary inclusion of *Aloe vera* and *Curcuma longa* and its combinations. This might be due to the consumption of isocaloric and isonitrogenous feed in all the treatment groups throughout the experimental period. T_3 and T_4 consumed numerically more feed than control group and among treatment groups T_7 consumed lower amount of feed (Sinurat *et al.*, 2002; Al-Sultan, 2003).

Table 1: Ingredients and nutrient composition (%DM) of broiler starter and finisher ration

Ingredients	Broiler starter	Broiler finisher
Maize	58.0	62.1
Soya	38.0	33.0
Calcite	2.5	2.6
DCP	1.5	1.5
Crude rice bran oil	-	0.8
Total	100.0	100.0
Supplements		
Vitamins AB_2D_3K[1]	0.010	0.010
B-Complex[2]	0.020	0.020
Trace minerals[3]	0.100	0.100
Lysine	0.050	0.050
Methionine	0.200	0.200
DOT[4]	0.050	0.050
Salt	0.350	0.350
Endox[5]	0.050	0.050
Toxin binder[6]	0.025	0.025
Total	0.855	0.855
Nutrients		
Crude protein	22.32	20.44
M.E (kcal/kg)*	2864	2944
Crude fibre	3.58	3.45
Ether extract	2.60	2.53
Total ash	6.68	6.76
Nitrogen free extract*	64.82	66.82
Calcium	1.06	1.05
Total Phosphorus	0.68	0.69
Lysine*	1.59	1.44
Methionine*	0.38	0.35

*Calculated values: [1]One gram of vitamin AB_2D_3K supplement contained 82500 IU of vitamin-A, 50 mg of vitamin-B_2, 12000 IU of vitamin-D_3 and 10 mg of vitamin-K. [2]One gram of B-complex supplement contained 80 mg of vitamin-B_1, 16 mg of vitamin-B_6, 80 mcg of vitamin-B_{12}, 80 mg of vitamin-E, 120 mg of niacin, 8 mg of folic acid, 80 mg of calcium pantothenate and 86 mg of calcium. [3]One gram of trace minerals contained 54 mg of manganese, 52 mg of zinc, 20 mg of iron, 2 mg of iodine and 1 mg of cobalt. [4]One gram of DOT contained Dinitro-ortho-toluamide 25 mg w/w. [5]Ethoxyquin, BHT and chelating agents. [6]Hydrated sodium alumino silicate (HSCAS), organic acids, vinylpyrrolidone homopolymer, mannanoligosaccharide (MOS) activated charcoal and lipotropic factors.

Feed conversion ratio (FCR): The analysis of data on mean feed conversion ratio revealed no significant difference between treatment groups up to sixth week of age except at first week. The mean cumulative feed conversion ratio in T_5 was significantly ($P < 0.01$) poorer compared to control group at first week of age. This trend was continued till end of the experimental period. It indicates that the inclusion of *Curcuma longa* at 0.2 percent level is not beneficial but at 0.1 percent level feed conversion ratio was numerically better than the control.

Table 2: Mean (±S.E.) body weight (g/bird) of broilers fed diet with *Aloe vera* and *Curcuma longa* and its combinations

Treatments	Hatch weight	I Week	II Week	III Week
T_1 Control	46.47±0.45	166.41^{a}±1.93	374.25±4.33	724.41±10.73
T_2 0.1% *Aloe vera*	46.34±0.34	157.80^{b}±1.63	367.44±3.89	722.06±8.92
T_3 0.2% *Aloe vera*	46.12±0.43	160.06^{ab}±2.19	371.52±7.01	731.19±14.21
T_4 0.1% *Curcuma longa*	47.16±0.63	162.84^{ab}±2.18	366.99±8.35	738.59±14.34
T_5 0.2% *Curcuma longa*	47.01±0.59	157.28^{b}±2.10	359.53±6.09	696.81±10.59
T_6 0.1% *Aloe vera*+0.1% *Curcuma longa*	46.21±0.46	164.82^{ab}±2.01	365.31±4.76	722.05±10.91
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	47.05±0.56	164.05^{ab}±1.99	370.49±3.99	717.55±9.59

Table 2: Continue

Treatments	Hatch weight	IV Week	V Week	VI Week
T_1 Control	46.47±0.45	1134.16±16.39	1458.05±25.72	1854.14±28.38
T_2 0.1% *Aloe vera*	46.34±0.34	1092.98±15.06	1448.65±22.65	1853.73±40.55
T_3 0.2% *Aloe vera*	46.12±0.43	1149.75±21.32	1493.31±28.82	1907.91±37.34
T_4 0.1% *Curcuma longa*	47.16±0.63	1150.85±23.54	1483.82±34.75	1898.66±42.68
T_5 0.2% *Curcuma longa*	47.01±0.59	1097.90±16.47	1460.06±21.19	1844.11±29.62
T_6 0.1% *Aloe vera* +0.1% *Curcuma longa*	46.21±0.46	1133.94±21.62	1475.72±29.16	1892.11±39.14
T_7 0.2% *Aloe vera* +0.2% *Curcuma longa*	47.05±0.56	1115.94±17.68	1461.45±26.76	1870.53±42.71

Each value is a mean of 40 observations. $^{a-b}$Means within a column with no common superscript differ significantly (P < 0.01)

Table 3: Mean (±S.E.) body weight gain (g/bird) of broilers fed diet with *Aloe vera* and *Curcuma longa* and its combinations

Treatments	I Week	II Week	III Week
T_1 Control	119.94^{a}±1.89	327.78±4.29	677.94±10.62
T_2 0.1% *Aloe vera*	111.46^{bc}±1.48	321.11±3.79	675.73±8.85
T_3 0.2% *Aloe vera*	113.95^{abc}±2.04	325.41±6.87	685.07±14.06
T_4 0.1% *Curcuma longa*	115.68^{abc}±1.90	319.81±8.17	691.53±14.07
T_5 0.2% *Curcuma longa*	110.28^{C}±1.97	312.52±5.96	649.81±10.51
T_6 0.1% *Aloe vera* + 0.1% *Curcuma longa*	118.61^{ab}±1.86	319.10±4.63	675.78±10.79
T_7 0.2% *Aloe vera* + 0.2% *Curcuma longa*	117.00^{abc}±1.90	323.44±3.95	670.50±9.63

Table 3: Continue

Treatments	IV Week	V Week	VI Week
T_1 Control	1087.69±16.30	1411.58±25.67	1807.74±28.35
T_2 0.1% *Aloe vera*	1046.64±14.99	1402.32±22.59	1807.39±40.48
T_3 0.2% *Aloe vera*	1103.64±21.20	1447.20±28.73	1861.80±37.25
T_4 0.1% *Curcuma longa*	1103.79±23.32	1436.73±34.52	1851.78±42.52
T_5 0.2% *Curcuma longa*	1050.90±16.37	1413.06±21.18	1797.08±29.62
T_6 0.1% *Aloe vera* + 0.1% *Curcuma longa*	1087.76±21.56	1429.55±29.03	1845.93±39.04
T_7 0.2% *Aloe vera* + 0.2% *Curcuma longa*	1068.82±17.74	1414.34±26.87	1823.51±42.79

Each value is a mean of 40 observations. $^{a-c}$Means within a column with no common superscript differ significantly (P < 0.01)

The inclusion of *Aloe vera* in broiler diet had no significant effect on feed conversion ratio. This was favourably compared with earlier report of Jiang Lin *et al.* (2005) who reported that no significant difference in feed conversion ratio was observed in growing chickens fed with *Aloe vera*.

On the contrary, Durrani *et al.* (2006) stated that supplementation of turmeric at the rate of 0.5 percent level resulted in better feed efficiency. Changkang *et al.* (2007) expressed similar opinion about the inclusion of *Aloe vera* in broiler diet.

Livability: The analysis of data on livability revealed no significant difference between treatment groups due to dietary inclusion of *Aloe vera* and *Curcuma longa* and its combinations. Livability was 100 percent in T_2 and T_3 groups at sixth week of age.

It was consistent with Kumar *et al.* (2005) who observed that when turmeric was supplemented (1 g/kg) in broiler diet during summer for 42 days had reduced mortality over those of control group. This can be also correlated with high titre values in treatment groups fed with 0.1 (T_2) and 0.2 (T_3) percent *Aloe vera* in this experiment.

Return over feed cost: The analysis of data on mean return over feed cost differs significantly (P < 0.01) between treatment groups up to six weeks of age. The return over feed cost per kilogram live weight of broiler at sixth week of age was high in T_4 compared to all other treatment groups which indicates that inclusion of *Curcuma longa* at 0.1 percent in broiler feed improved growth rate with better feed conversion.

Similarly, Namagirilakshmi (2005) observed that the cost of feed to produce one kg live broiler chicken was lowest in 0.50 percent turmeric supplemented groups.

The mean return over feed cost of T_3 and T_7 were

Table 4: Mean (±S.E.) cumulative feed consumption (g/bird) of broilers fed diet with *Aloe vera* and *Curcuma longa* and its combinations

Treatments	I Week	II Week	III Week
T_1 Control	134.11±1.93	498.53±3.88	1107.60±12.01
T_2 0.1% *Aloe vera*	132.95±1.32	496.15±3.77	1101.16±24.40
T_3 0.2% *Aloe vera*	136.52±1.99	495.57±5.75	1105.28±17.03
T_4 0.1% *Curcuma longa*	133.30±3.22	496.83±11.01	1105.48±32.94
T_5 0.2% *Curcuma longa*	137.04±1.35	501.22±2.74	1093.65±6.60
T_6 0.1% *Aloe vera*+0.1% *Curcuma longa*	136.12±2.32	500.49±4.92	1099.68±14.02
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	135.08±1.41	503.40±1.82	1098.22±4.26

Each value is a mean of 4 observations

Table 4: Continue

Treatments	IV Week	V Week	VI Week
T_1 Control	1849.56±29.33	2656.16±27.48	3490.14±38.49
T_2 0.1% *Aloe vera*	1804.26±59.42	2666.54±81.63	3427.34±81.94
T_3 0.2% *Aloe vera*	1852.36±38.91	2682.75±35.81	3548.91±32.82
T_4 0.1% *Curcuma longa*	1813.43±60.33	2676.67±75.80	3537.22±110.70
T_5 0.2% *Curcuma longa*	1815.07±19.14	2637.96±28.11	3480.16±54.19
T_6 0.1% *Aloe vera*+0.1% *Curcuma longa*	1813.71±54.67	2670.39±70.49	3494.57±114.55
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	1821.28±17.04	2640.93±25.53	3403.61±50.23

Each value is a mean of 4 observations

Table 5: Mean (±S.E.) cumulative feed conversion ratio of broilers fed diet with *Aloe vera* and *Curcuma longa* and its combinations

Treatments	I Week	II Week	III Week
T_1 Control	1.12^{a}±0.02	1.52±0.02	1.63± 0.02
T_2 0.1% *Aloe vera*	$1.20B^{cd}$±0.02	1.55±0.01	1.63±0.03
T_3 0.2% *Aloe vera*	$1.20B^{cd}$±0.02	1.52±0.01	1.62±0.01
T_4 0.1% *Curcuma longa*	1.16^{abc}±0.02	1.56±0.05	1.59±0.03
T_5 0.2% *Curcuma longa*	1.25^{D}±0.02	1.60±0.02	1.68±0.02
T_6 0.1% *Aloe vera*+0.1% *Curcuma longa*	1.15^{ab}±0.01	1.57±0.03	1.63±0.03
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	1.16^{abc}±0.02	1.56±0.01	1.64±0.01

Table 5: Continue

Treatments	IV Week	V Week	VI Week
T_1 Control	1.70± 0.02	1.88± 0.02	1.93± 0.01
T_2 0.1% *Aloe vera*	1.72±0.02	1.90±0.02	1.90±0.02
T_3 0.2% *Aloe vera*	1.68±0.02	1.85±0.02	1.91±0.02
T_4 0.1% *Curcuma longa*	1.64±0.02	1.86±0.03	1.91±0.02
T_5 0.2% *Curcuma longa*	1.73±0.01	1.87±0.03	1.94±0.01
T_6 0.1% *Aloe vera*+0.1% *Curcuma longa*	1.67±0.02	1.87±0.03	1.89±0.04
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	1.71±0.01	1.87±0.02	1.88±0.04

Each value is a mean of 4 observations. $^{a-d}$Means within a column with no common superscript differ significantly ($P < 0.01$)

Table 6: Mean (±S.E.) percent livability of broilers fed diet with *Aloe vera* and *Curcuma longa* and its combinations

Treatments	I Week	II Week	III Week
T_1 Control	100.00±0.00	100.00±0.00	100.00±0.00
T_2 0.1% *Aloe vera*	100.00±0.00	100.00±0.00	100.00±0.00
T_3 0.2% *Aloe vera*	100.00±0.00	100.00±0.00	100.00±0.00
T_4 0.1% *Curcuma longa*	100.00±0.00	99.30±0.007	93.50±0.039
T_5 0.2% *Curcuma longa*	100.00±0.00	100.00±0.00	100.00±0.00
T_6 0.1% *Aloe vera*+ 0.1% *Curcuma longa*	100.00±0.00	100.00±0.00	99.30±0.07
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	100.00±0.00	100.00±0.00	100.00±0.00

Table 6: Continue

Treatments	IV Week	V Week	VI Week
T_1 Control	100.00±0.00	100.00±0.00	99.30±0.007
T_2 0.1% *Aloe vera*	100.00±0.00	100.00±0.00	100.00±0.00
T_3 0.2% *Aloe vera*	100.00±0.00	100.00±0.00	100.00±0.00
T_4 0.1% *Curcuma longa*	92.50±0.048	90.80±0.064	88.30±0.71
T_5 0.2% *Curcuma longa*	100.00±0.00	100.00±0.00	98.30±0.018
T_6 0.1% *Aloe vera*+ 0.1% *Curcuma longa*	96.50±0.024	95.00±0.029	95.00±0.029
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	99.30±0.007	97.50±0.025	97.30±0.028

Each value is a mean of 4 observations

Table 7: Mean (±S.E.) return over feed cost (Rs./kg live weight) of broilers fed diet with *Aloe vera* and *Curcuma longa* and its combinations

Treatments	Cost of feed/kg (Rs.)	I Week	II Week	III Week
T_1 Control	13.15	3.04^{a}±0.08	6.56^{a}±0.12	12.56^{ab}±0.29
T_2 0.1% *Aloe vera*	14.35	2.55^{bc}±0.07	5.72^{abc}±0.09	11.23^{bcd}±0.31
T_3 0.2% *Aloe vera*	15.55	2.44^{c}±0.08	5.31^{bc}±0.19	10.22^{cde}±0.23
T_4 0.1% *Curcuma longa*	13.30	2.86^{ab}±0.13	6.23^{ab}±0.50	13.12^{a}±0.82
T_5 0.2% *Curcuma longa*	13.40	2.58^{bc}±0.10	5.79^{abc}±0.15	11.34^{bc}±0.39
T_6 0.1% *Aloe vera*+0.1% *Curcuma longa*	14.50	2.77^{abc}±0.07	5.51^{bc}±0.21	11.11^{bcde}±0.40
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	15.80	2.55^{bc}±0.09	4.99^{c}±0.08	9.47^{e}±0.10

Table 7: Continue

Treatments	Cost of feed/kg (Rs.)	IV Week	V Week	VI Week
T_1 Control	13.15	19.20^{ab}±0.37	21.54^{ab}±0.59	26.49^{ab}±0.49
T_2 0.1% *Aloe vera*	14.35	15.98^{cde}±0.36	18.01^{de}±0.50	23.11^{bcde}±0.56
T_3 0.2% *Aloe vera*	15.55	15.34^{de}±0.42	16.17^{def}±0.61	19.29^{f}±0.82
T_4 0.1% *Curcuma longa*	13.30	20.25^{a}±1.19	22.18^{a}±1.30	27.26^{a}±0.59
T_5 0.2% *Curcuma longa*	13.40	17.72^{bc}±0.35	21.17^{abc}±1.01	25.24^{abc}±0.40
T_6 0.1% *Aloe vera*+0.1% *Curcuma longa*	14.50	17.83^{bcd}±0.38	18.50^{bcd}±0.57	23.31^{bcd}±0.92
T_7 0.2% *Aloe vera*+0.2% *Curcuma longa*	15.80	14.00^{e}±0.29	14.80^{f}±0.53	18.80^{f}±1.69

Each value is a mean of 4 observations. $^{a-f}$Means within a column with no common superscript differ significantly (P < 0.01)

significantly (P < 0.01) lower than control group at sixth week of age. The significance in return over feed cost in all weeks of age is mainly due to variations in the feed cost (from Rs. 13.15-15.80 per kg of feed) due to inclusion of *Aloe vera* and *Curcuma longa*.

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