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Effects of feeding different levels of formalin (37% formaldehyde) and urea on broiler health and performance

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ABSTRACT

This study was conducted on 280 birds divided into seven groups at 21 days of age and were given urea and formalin, alone and in combination through basal feed. Recorded observations revealed that at the end of the 3rd week, live mass and dressed carcass mass of birds given milder levels of urea and formalin (U-1% and F-2.5 ml) differed non-significantly from that of the control group, while these levels were lower in other treatment groups. Absolute mass of thymus was significantly lower ($P<0.05$) in all treatment groups except those given 20-ml formalin along with different levels of urea (1% and 4%), while that of the bursa was lower in all treatment groups. Absolute mass of spleen was significantly lower ($P<0.05$) in birds given 1% urea + 2.5 ml formalin and 4% urea + 20 ml formalin, while that of liver and kidney was lower ($P<0.05$) in birds given 20 ml formalin and in those given higher concentration of urea, along with two levels of formalin, than the control group (U-4%+F-2.5 ml; U-4%+F-20 ml). A non-significant difference was observed in absolute heart, proventriculus and gizzard masses between treatment and control birds. Feed consumption at the third week was significantly higher ($P< 0.05$) in birds given 20 ml formalin alone, or with 1% urea, than the control group. Final results of serum total proteins, albumin and fibrinogen showed a non-significant difference between treatment and control groups. However, serum globulins were significantly higher ($P<0.05$) in birds fed 1% urea + 20 ml formalin than the control group.

Key words: urea, formalin, live mass, carcass mass, organ mass, serum, proteins, broilers

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Introduction

Poultry feed is composed of raw or processed ingredients derived from crops and animal products. The ingredients, such as cereals, meals of different seeds, fish and meat meal, are contaminated by a variety of microorganisms (BABAR, 1997), while fish and meat meal are often adulterated with urea to increase protein concentration (PERVAZ et al., 1996).

Some of the contaminating microorganisms prove pathogenic to the chicks and can enter into circulation through the digestive tract. A feed having a higher number of bacteria and fungi increases the chance of establishing local or systemic infections. Incorporation of various antibacterial and antifungal substances in feed for reducing the number of contaminating organisms is in practice. Use of formalin in feed has proven fairly successful in achieving the desired results (BABAR, 1997). Formalin is a highly germicidal chemical and is not inactivated in the presence of organic matter. Nevertheless, formaldehyde has a pungent odour and is highly irritant to mucus membranes. Formalin at higher levels (10 ml/kg or above) is reported to be harmful to chickens. The higher level produces anorexia, depression and staggering gait, while low level (2.5 ml/kg) in broilers did not affect the feed intake, body mass and FCR, but proved to be bactericidal (BABAR, 1997).

In non- ruminants, some researchers have suggested that urea is unable to be utilized and that it has no nutritional value for poultry (KOBAYASHI et al., 1981). Others suggest that urea may replace some non- essential amino acids in diet of non-ruminants (SUCIO et al., 1990). However, significant increase in mass gain has been observed when low levels of urea were used in broiler chicks (PERVAZ et al., 1996). It has been reported that gut microorganisms are responsible for the growth-promoting effect of urea in chicks. The germ-free chicks did not benefit from the supplement, either in mass gain or feed conversion ratio (OKUMURA et al., 1976). Higher levels of urea are also reported to be toxic to chickens (GUO, 1983; CHANDRA et al., 1984; JABBAR, 1994; PERVAZ et al., 1996; HUSSAIN, 1995).

There are isolated reports on the usefulness and toxicity of formaldehyde and urea, but there is no published report on the combined effects of urea and formalin in poultry. The present study was therefore designed to study

the combined effects of formalin and urea (different levels of urea and formalin in combinations) on body mass, carcass mass, organs mass, and feed consumption, along with serum total proteins and fractions in broilers.

Materials and methods

A total of 280 day-old commercial broiler chicks were procured from a local hatchery and were kept in cages under standard conditions of management. Fresh water and basal feed (broiler chick starter mash, 22% protein) was provided *ad libitum* for three weeks. The birds were then divided into seven groups (A to G), 40 chicks in each group. From day 21 onwards chicks were given formaldehyde (37%) and urea alone and in combination, in the basal feed, up to six weeks of age, as indicated below.

Group - Formalin and urea concentrations

A - Control

B - 40 gram urea/kg feed

C - 20 ml formalin/kg feed

D - 10 gram urea + 2.5 ml formalin/kg feed

E - 10 gram urea + 20 ml formalin/kg feed

F - 40 gram urea + 2.5 ml formalin/kg feed

G - 40 gram urea + 20 ml formalin/kg feed

Eight feed samples were collected for the determination of protein content in the samples by the Kjeldahl method (HILLER et al., 1948). Weekly live body mass, dressed carcass mass, organ mass (heart, liver, thymus, bursa, spleen, kidney, gizzard, proventriculus) were recorded and daily feed intake per group was also recorded.

At the end of every week, 10 birds from each group were slaughtered for collection of blood samples. Blood collected was used for separation of plasma and serum for further studies. Plasma fibrinogen concentration was estimated using the method as described by BENJAMIN (1978). Serum total proteins were estimated by the biuret method (OSER, 1976) and albumin by the bromocresol green dye binding method (VARLEY et al., 1980). Serum globulins were determined by subtracting albumin from total protein values.

The data thus obtained on different parameters were analyzed by using SAS statistical computer package (ANONYMOUS, 1996) by analysis of variance technique, and means were compared by using LSD and DMR tests.

Results

Live mass and carcass mass. The results of live mass at the end of the third week showed significantly ($P<0.05$) lower values in all treatment groups, except birds given lower levels of both urea and formalin in combination (U-1% + F-2.5 ml) than the control group (Table 1). However, after the end of first week the value was lower ($P<0.05$) only in birds fed 4% urea alone than the control group, while the results were non-significant after the end of the second week (Table 1). Among treatment groups, at the end of the third week it was lower in birds fed higher levels of formalin (20 ml) alone or with higher levels of urea (4%) and in those fed higher levels of urea, along with milder levels of formalin (U-4% + F-2.5 ml) than the other treatment groups.

Dressed carcass mass at the end of third week was also lower in all treatment groups as for live mass, except birds fed milder levels of urea and formalin in combination (U-1% + F-2.5 ml) than the control group (Table 1). Dressed carcass mass, unlike live mass, showed a non-significant difference between treatment and control groups after the end of the first week, whereas after the end of the second week it was lower in all treatment groups than in the control group, except those fed higher levels of urea (4%) alone. Among treatment groups, at the end of third week dressed carcass mass was lower in birds fed higher levels of formalin (20 ml) alone or with higher levels of urea (4%) than in those fed milder levels of both urea and formalin in combination (U-1 % + F-2.5 ml).

Mass of different organs. Thymus mass after the end of third week showed significantly lower levels in all treatment groups except those fed higher levels of formalin (20 ml) in combination with two levels of urea (1 and 4%) than in the control group (Table 2). However, after the end of the first and second weeks thymus mass was higher in birds fed higher levels of urea (4%) in combination with two levels of formalin (2.5 and 20 ml)

Table 1. Specification of myomorphus mammals examined by renoculture and microscopic agglutination acording to the trapping area with corresponding results

Table 1. Means ± s.d. of live mass and dressed carcase mass of broilers fed urea and formaldehyde alone and in combination through basal feed, and of those fed only basal feed (control)

Groups	Weeks			
	0	1	2	3
Live mass (g)				
Control	326.75 ^{d} ± 71.18	719.75 ^{ABc} ± 50.16	1011.25 ^{b} ± 113.45	1446.25 ^{Aa} ± 3.07
U - 4%	338.50 ^{d} ± 86.13	556.25 ^{Cc} ± 80.24	986.25 ^{b} ± 168.59	1206.25 ^{Ba} ± 154.45
F - 20 ml	285.50 ^{c} ± 81.03	770.00 ^{Ab} ± 37.85	956.66 ^{a} ± 92.37	1027.50 ^{CDa} ± 81.70
U -1% F - 2.5 ml	322.00 ^{d} ± 65.62	605.00 ^{BCc} ± 100.24	1092.50 ^{b} ± 162.55	1300.00 ^{ABa} ± 100.99
U - 1% F - 20 ml	278.00 ^{d} ± 87.76	643.75 ^{ABDc} ± 118.35	945.00 ^{b} ± 108.09	1161.25 ^{BCa} ± 134.86
U - 4% F - 2.5 ml	225.00 ^{c} ± 17.32	687.50 ^{ABb} ± 83.06	953.75 a ± 86.73	1001.25 ^{CDa} ± 127.63
U - 4% F - 20 ml	258.75 ^{c} ± 78.79	707.50 ^{ABb} ± 62.51	920.00 ^{a} ± 139.70	968.75 ^{Da} ± 6.33
Dressed carcass mass (g)				
Control	234.75 ^{c} ± 52.96	545.37 ^{ABb} ± 30.33	752.50 ^{Aa} ± 69.94	815.75 ^{Aa} ± 47.20
U - 4 %	246.25 ^{c} ± 62.19	452.25 ^{Bb} ± 78.69	735.00 ^{Aa} ± 155.24	655.25 ^{BCa} ± 88.78
F - 20 ml	204.00 ^{c} ± 56.61	565.75 ^{Aa} ± 28.62	493.66 ^{Bb} ± 39.57	581.75 ^{Ca} ± 28.62
U - 1% F - 2.5 ml	233.75 ^{d} ± 51.85	461.00 ^{ABc} ± 70.28	575.00 ^{Bb} ± 30.47	741.25 ^{ABa} ± 61.42
U - 1% F - 20 ml	199.75 ^{c} ± 60.52	483.25 ^{ABb} ± 97.12	524.00 ^{Bb} ± 68.29	647.00 ^{BCa} ± 74.09
U - 4% F - 2.5 ml	161.50 ^{c} ± 9.81	493.75 ^{ABb} ± 79.73	515.25 ^{Bb} ± 56.05	668.25 ^{BCa} ± 58.08
U - 4% F - 20 ml	188.00 ^{b} ± 59.21	540.25 ^{ABa} ± 33.56	518.75 ^{Ba} ± 75.99	571.25 ^{Ca} ± 66.29

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

Table 2. Means ± s.d. of absolute mass of thymus and bursa of broilers fed urea and formaldehyde alone and in combination through basal feed, and of those fed basal feed only (control)

Groups	Weeks			
	0	1	2	3
Thymus mass (g)				
Control	1.10 ^{c} ± 0.12	1.55 ^{CDc} ± 0.19	4.27 ^{Cb} ± 0.46	6.30 ^{Aa} ± 0.38
U - 4%	1.13 ^{c} ± 0.09	1.30 ^{Dc} ± 0.18	3.98 ^{Cb} ± 0.48	5.60 ^{Ba} ± 0.28
F - 20 ml	1.08 ^{c} ± 0.09	1.77 ^{CDb} ± 0.21	4.66 ^{BCa} ± 0.42	4.83 ^{CDa} ± 0.13
U -1% F - 2.5 ml	1.15 ^{b} ± 0.10	1.57 ^{CDb} ± 0.52	4.85 ^{BCa} ± 0.50	5.00 ^{Ca} ± 0.16
U - 1% F - 20 ml	1.10 ^{d} ± 0.08	2.02 ^{BCc} ± 0.26	4.55 ^{BCb} ± 0.66	6.10 ^{Aa} ± 0.26
U - 4% F - 2.5 ml	1.05 ^{d} ± 0.06	2.60 ^{Ac} ± 0.43	5.37 ^{Ba} ± 0.87	4.45 ^{Db} ± 0.44
U - 4% F - 20 ml	1.10 ^{c} ± 0.08	2.27 ^{ABb} ± 0.17	6.45 ^{Aa} ± 0.55	6.00 ^{ABa} ± 0.33
Bursa mass (g)				
Control	1.23 ^{ab} ± 0.33	1.75 ^{BCa} ± 0.72	1.05 ^{ABCbc} ± 0.19	0.45 ^{Ac} ± 0.13
U - 4 %	1.30 ^{ab} ± 0.27	1.10 ^{Ca} ± 0.08	1.40 ^{Ab} ± 0.18	0.28 ^{Bc} ± 0.09
F - 20 ml	1.20 ^{b} ± 0.37	3.35 ^{Aa} ± 0.99	1.0 ^{BCbc} 2.0 ± 0.20	0.23 ^{Bc} ± 0.05
U - 1% F - 2.5 ml	1.10 ^{b} ± 0.12	2.08 ^{Ba} ± 0.56	1.18 ^{ABb} ± 0.24	0.23 ^{Bc} ± 0.05
U - 1% F - 20 ml	1.23 ^{b} ± 0.32	2.33 ^{Ba} ± 0.43	0.80 ^{Cb} ± 0.22	0.20 ^{Bc} ± 0.08
U - 4% F - 2.5 ml	1.05 ^{b} ± 0.06	1.53 ^{BCa} ± 0.25	0.78 ^{Cc} ± 0.17	0.18 ^{Bd} ± 0.05
U - 4% F - 20 ml	1.10 ^{b} ± 0.08	2.03 ^{Ba} ± 0.41	1.10 ^{ABCb} ± 0.32	0.20 ^{Bc} ± 0.08

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

Table 3. Means ± s.d. of absolute mass of spleen and liver of broilers fed urea and formaldehyde alone and in combination through basal feed, and of those fed only basal feed (control)

Groups	Weeks			
	0	1	2	3
Spleen mass (g)				
Control	0.58 ^{b} ± 0.09	1.78 ^{ABa} ± 0.13	2.15 ^{ABCa} ± 0.77	2.20 ^{ABa} ± 0.36
U - 4%	0.55 ^{c} ± 0.06	1.63 ^{Bb} ± 0.59	2.83 ^{Aa} ± 0.70	2.30 ^{Aab} ± 0.48
F - 20 ml	0.60 ^{d} ± 0.08	1.73 ^{ABb} ± 0.09	1.33 ^{Cc} ± 0.29	2.43 ^{Aa} ± 0.31
U -1% F - 2.5 ml	0.55 ^{c} ± 0.10	2.30 ^{Aa} ± 0.26	2.38 ^{ABa} ± 0.34	1.63 ^{Cb} ± 0.25
U - 1% F - 20 ml	0.63 ^{c} ± 0.05	1.80 ^{ABb} ± 0.43	2.65 ^{ABb} ± 0.62	2.63 ^{Aa} ± 0.25
U - 4% F - 2.5 ml	0.55 ^{c} ± 0.06	2.28 ^{Aa} ± 0.22	1.43 ^{Cb} ± 0.42	1.78 ^{BCab} ± 0.45
U - 4% F - 20 ml	0.55 ^{b} ± 0.06	1.65 ^{Ba} ± 0.59	1.83 ^{BCa} ± 0.24	1.45 ^{Ca} ± 0.10
Liver mass (g)				
Control	11.13 ^{d} ± 2.56	26.60 $^{A c}$ ± 4.94	34.38 ^{ABb} ± 1.25	40.75 ^{Aa} ± 1.50
U - 4 %	12.30 ^{c} ± 1.57	25.30 $^{AB b}$ ± 1.26	33.50 ^{ABCa} ± 6.56	36.86 ^{ABa} ± 5.11
F - 20 ml	10.30 ^{c} ± 2.01	23.83 ^{ABCb} ± 0.62	27.83 ^{Ca} ± 3.33	26.75 ^{Dab} ± 1.71
U - 1% F - 2.5 ml	11.50 ^{c} ± 2.83	22.30 ^{ABCb} ± 2.03	35.25 ^{Aa} ± 0.96	35.30 ^{ABCa} ± 3.63
U - 1% F - 20 ml	10.98 ^{d} ± 0.92	19.70 ^{Cc} ± 1.52	31.38 ^{ABCb} ± 3.73	36.13 ^{ABa} ± 3.97
U - 4% F - 2.5 ml	8.85 ^{c} ± 1.56	21.13 ^{BCb} ± 2.81	34.00 ^{ABCa} ± 4.71	29.63 ^{CDa} ± 5.44
U - 4% F - 20 ml	10.35 ^{c} ± 2.46	25.45 ^{ABb} ± 4.01	28.23 ^{Bcab} ± 2.17	31.25 ^{BCDa} ± 4.50

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

Table 4. Means ± s.d. of absolute mass of kidney and heart of broilers fed urea and formaldehyde alone and in combination through basal feed, and of those fed only basal feed (control)

Groups	Weeks			
	0	1	2	3
Kidney mass (g)				
Control	3.93 ^{d} ± 1.02	8.90 ^{c} ± 0.35	10.45 ^{b} ± 1.06	13.00 ^{Aa} ± 0.82
U - 4%	4.28 ^{c} ± 1.05	8.55 ^{b} ± 1.38	10.00 ^{ab} ± 1.08	11.63 ^{Aa} ± 0.75
F - 20 ml	3.40 ^{c} ± 0.96	8.88 ^{b} ± 0.15	9.00 ^{ab} ± 0.21	9.80 ^{Ba} ± 0.28
U -1% F - 2.5 ml	3.92 ^{d} ± 1.02	8.08 ^{c} ± 0.68	10.33 ^{b} ± 1.03	12.13 ^{Aa} ± 1.25
U - 1% F - 20 ml	3.35 ^{d} ± 0.99	8.10 ^{c} ± 1.09	9.88 ^{b} ± 1.44	12.00 ^{Aa} ± 0.82
U - 4% F - 2.5 ml	2.80 ^{c} ± 0.12	8.28 ^{b} ± 1.07	9.85 ^{a} ± 1.39	9.88 ^{Ba} ± 0.63
U - 4% F - 20 ml	3.28 ^{b} ± 1.02	8.20 ^{a} ± 0.78	10.03 ^{a} ± 1.13	9.63 ^{Ba} ± 1.65
Heart mass (g)				
Control	2.38 ^{c} ± 0.39	6.03 ^{Ab} ± 0.46	6.55 ^{BCDab} ± 0.49	7.25 ^{a} ± 0.64
U - 4 %	2.63 ^{d} ± 0.13	4.93 ^{Bc} ± 0.57	8.38 ^{Aa} ± 0.75	6.63 ^{b} ± 0.95
F - 20 ml	2.35 ^{c} ± 0.37	5.95 ^{Ab} ± 0.39	6.00 ^{CDb} ± 0.50	6.85 ^{a} ± 0.72
U - 1% F - 2.5 ml	2.33 ^{c} ± 0.32	5.33 ^{ABb} ± 0.59	7.65 ^{ABa} ± 0.84	6.75 ^{a} ± 1.04
U - 1% F - 20 ml	2.45 ^{d} ± 0.33	5.10 ^{Bc} ± 0.54	5.83 ^{Db} ± 0.63	7.25 ^{a} ± 0.29
U - 4% F - 2.5 ml	2.30 ^{b} ± 0.23	5.38 ^{ABa} ± 0.51	6.13 ^{CDa} ± 0.48	5.88 ^{a} ± 0.85
U - 4% F - 20 ml	2.43 ^{c} ± 0.22	4.75 ^{Bb} ± 0.10	7.18 ^{ABCa} ± 1.41	5.88 ^{ab} ± 1.44

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

Table 5. Means ± s.d. of absolute mass of proventriculus and gizzard of broilers fed urea and formaldehyde alone and in combination through basal feed, and of those fed only basal feed (control)

Groups	Weeks			
	0	1	2	3
Proventriculus mass (g)				
Control	2.98 ^{b} ± 1.13	6.33 ^{a} ± 1.16	7.30 ^{ABa} ± 0.63	7.38 ^{a} ± 1.49
U - 4%	3.25 ^{c} ± 0.87	5.50 ^{b} ± 0.92	8.68 ^{Aa} ± 2.05	7.25 ^{ab} ± 1.32
F - 20 ml	2.60 ^{b} ± 0.91	7.13 ^{a} ± 1.18	6.33 ^{Ba} ± 0.76	7.28 ^{a} ± 1.18
U -1% F - 2.5 ml	3.35 ^{c} ± 1.17	6.03 ^{b} ± 0.39	8.50 ^{ABa} ± 1.58	6.88 ^{ab} ± 1.11
U - 1% F - 20 ml	2.83 ^{c} ± 0.65	5.90 ^{b} ± 0.93	6.50 ^{ABab} ± 1.00	7.50 ^{a} ± 0.41
U - 4% F - 2.5 ml	2.05 ^{c} ± 0.52	5.63 ^{b} ± 0.53	7.03 ^{ABab} ± 1.37	8.25 ^{a} ± 1.44
U - 4% F - 20 ml	2.65 ^{b} ± 0.99	6.00 ^{a} ± 1.40	6.70 ^{ABa} ± 1.31	6.75 ^{a} ± 0.65
Gizzard mass (g)				
Control	14.23 ^{b} ± 4.45	27.80 ^{a} ± 2.34	29.55 ^{Aa} ± 5.01	29.50 a ± 4.78
U - 4 %	14.78 ^{b} ± 3.89	22.73 ^{b} ± 3.84	23.25 ^{ABb} ± 2.36	32.10 ^{a} ± 9.82
F - 20 ml	13.83 ^{b} ± 4.62	27.70 ^{a} ± 2.74	28.50 ^{ABa} ± 8.67	28.50 ^{a} ± 5.90
U - 1% F - 2.5 ml	12.45 ^{c} ± 1.64	22.38 ^{b} ± 4.17	25.45 ^{ABb} ± 4.68	30.50 ^{a} ± 0.71
U - 1% F - 20 ml	14.28 ^{c} ± 4.19	22.45 ^{b} ± 2.32	21.13 ^{Bb} ± 0.25	30.50 ^{a} ± 2.65
U - 4% F - 2.5 ml	10.90 ^{b} ± 1.04	23.30 ^{a} ± 2.97	27.00 ^{ABa} ± 5.40	24.25 ^{a} ± 4.86
U - 4% F - 20 ml	11.75 ^{b} ± 1.39	23.45 ^{a} ± 4.46	23.50 ^{ABa} ± 2.16	26.38 ^{a} ± 5.02

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

Table 6. Means ± s.d. of total protein and fibrinogen in broilers fed urea and formaldehyde alone and in combination through basal feed, and of those fed basal feed only (control) at weekly intervals for three weeks

Groups	Weeks		
	1	2	3
Total protein (g/100 ml)			
Control	3.45 ± 1.31	4.61 ± 0.38	3.91 ± 0.69 ^{AB}
U - 4 %	3.39 ± 1.36	4.06 ± 1.17	5.03 ± 0.74 ^{A}
F - 20 ml	3.51 ± 0.65	3.85 ± 0.53	3.85 ± 0.78 ^{B}
U - 1%; F - 2.5 ml	3.37 ± 0.90	3.81 ± 0.60	4.13 ± 0.83 ^{AB}
U - 1%; F - 20 ml	3.15 ± 0.77	4.45 ± 1.39	4.25 ± 0.57 ^{AB}
U - 4%; F - 2.5 ml	4.07 ± 0.16 ^{ab}	3.35 ± 0.65 ^{b}	4.36 ± 0.72 ^{ABa}
U - 4 %; F - 20 ml	3.88 ± 0.34	4.13 ± 1.07	3.87 ± 0.42 ^{B}
Fibrinogen (g/100 ml)			
Control	2.10 ± 1.51 ^{AB}	0.94 ± 0.36 ^{AB}	2.15 ± 0.71
U - 4 %	2.05 ± 0.74 ^{AB}	1.49 ± 0.35 ^{AB}	1.94 ± 1.67
F - 20 ml	0.46 ± 0.30 ^{B}	1.60 ± 1.59 ^{AB}	1.34 ± 1.38
U - 1 %; F - 2.5 ml	3.11 ± 1.47 ^{A}	1.94 ± 0.76 ^{AB}	1.96 ± 1.45
U - 1 %; F - 20 ml	1.77 ± 1.51 ^{AB}	0.77 ± 0.78 ^{B}	1.69 ± 1.34
U - 4 %; F - 2.5 ml	0.42 ± 0.15 ^{Bb}	1.16 ± 0.40 ^{ABab}	1.90 ± 0.97 ^{a}
U - 4 %; F - 20 ml	0.54 ± 0.46 ^{B}	2.19 ± 0.91 ^{A}	2.23 ± 1.24

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

than in the control group. Among treatment groups, at the end of the third week the level was higher in birds fed higher levels of formalin (20 ml) in combination with two levels of urea (1 and 4%), and in those fed higher levels of urea alone (4%), than in other treatment groups.

Bursal mass recorded at the end of third week was significantly lower in all treatment groups than in the control group, with a non-significant difference between them (Table 2). After the end of first week, the level was lower only in birds fed higher levels of formalin than in the control

Table 7. Means ± s.d. of albumin and globulins in broilers fed urea and formaldehyde alone and in combination through basal feed, and of those fed basal feed only (control) at weekly intervals for three weeks

Groups	Weeks		
	1	2	3
Albumin (g/100 ml)			
Control	1.94 ± 0.10 ^{Bb}	2.26 ± 0.47 ^{b}	3.21 ± 0.40 ^{ABa}
U - 4 %	2.37 ± 0.48 ^{AB}	2.21 ± 0.55	3.48 ± 1.14 ^{A}
F - 20 ml	2.24 ± 0.31 ^{AB}	2.20 ± 0.76	3.01 ± 0.58 ^{AB}
U - 1%; F - 2.5 ml	2.97 ± 0.83 ^{A}	2.65 ± 0.51	3.28 ± 0.52 ^{AB}
U - 1%; F - 20 ml	2.08 ± 0.39 ^{B}	2.81 ± 0.84	2.26 ± 0.43 ^{B}
U - 4%; F - 2.5 ml	2.68 ± 0.41 ^{AB}	2.42 ± 0.52	3.25 ± 0.56 ^{AB}
U - 4 %; F - 20 ml	2.95 ± 0.48 ^{A}	2.64 ± 0.56	2.74 ± 0.66 ^{AB}
Globulins (g/100 ml)			
Control	1.50 ± 1.38 ^{ab}	2.35 ± 0.44 ^{Aa}	0.70 ± 0.42 ^{Bb}
U - 4 %	1.02 ± 1.45	1.86 ± 0.91 ^{AB}	1.55 ± 1.27 ^{AB}
F - 20 ml	1.27 ± 0.70	1.65 ± 0.89 ^{AB}	0.84 ± 1.03 ^{AB}
U - 1 %; F - 2.5 ml	0.40 ± 0.30	1.16 ± 0.79 ^{AB}	0.85 ± 0.36 ^{AB}
U - 1 %; F - 20 ml	1.07 ± 0.78	1.64 ± 0.91 ^{AB}	1.99 ± 0.52 ^{A}
U - 4 %; F - 2.5 ml	1.39 ± 0.55	0.93 ± 0.66 ^{B}	1.12 ± 0.27 ^{AB}
U - 4 %; F - 20 ml	0.92 ± 0.68	1.49 ± 0.57 ^{AB}	1.13 ± 0.68 ^{AB}

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

group, while the difference between treatment groups and controls was non-significant after the end of second week.

Spleen mass after the end of third week was significantly lower in birds fed lower (U-1% + F-2.5 ml) and higher (U-4 % + F-20 ml) levels of both urea and formalin in combination than in the control group and in almost all other treatment groups (Table 3). However, a non-significant difference was observed at the end of the first and second weeks between treatment groups and the control group.

Table 8. Means ± s.d. of feed consumed (g) per bird, fed urea and formaldehyde alone and in combination through basal feed, and in those fed basal feed only (control)

Groups	Weeks		
	1	2	3
Control	69.36 ^{Cb} ± 8.04	95.25 ^{Bab} ± 27.08	114.28 ^{Bb} ± 37.79
U - 4 %	119.01 Aab ± 20.55	95.26 ^{Bb} ± 44.94	150.00 ^{ABa} ± 40.82
F - 20 ml	64.28 ^{Cb} ± 211.57	147.95 ^{ABa} ± 419.04	200.00 ^{Aa} ± 188.98
U -1% F - 2.5 ml	100.99 ^{Ba} ± 23.19	127.02 ^{ABa} ± 52.84	128.57 ^{Ba} ± 26.73
U - 1% F - 20 ml	79.12 ^{Cc} ± 14.54	126.98 $^{AB\ b}$ ± 27.11	201.78 ^{Aa} ± 65.52
U - 4% F - 2.5 ml	96.50 ^{Bb} ± 15.65	150.80 ^{Aa} ± 31.50	108.57 ^{Bab} ± 62.03
U - 4% F - 20 ml	64.83 ^{Cb} ± 7.17	123.02 ^{ABa} ± 50.33	141.07 ^{ABa} ± 71.34

In this table, values with small letters in a row and with capital letters in a column are significant at $P<0.05$. The letters U and F represent urea and formalin, respectively.

Liver mass at the end of the third week was lower in birds fed higher levels of formalin (20 ml) alone or in combination with higher levels of urea (F-20 ml + U-4 %), and also in birds fed higher levels of urea in combination with lower levels of formalin (U-4 % + F-2.5 ml) than in the control group (Table 3). After the end of the first week, liver mass was lower ($P<0.05$) in birds fed higher levels of urea in combination with lower levels of formalin (U-4% + F-2.5 ml) and those fed higher levels of formalin in combination with lower levels of urea (F- 20 ml + U-1%) than in the control group, whereas after the end of the second week mass was lower ($P<0.05$) only in birds fed higher levels of formalin alone (F-20 ml) than in the control group. Among treatment groups, after the end of third week mass was lower in birds fed higher levels of formalin (20 ml) alone and in those fed

higher levels of urea in combination with lower levels of formalin (U- 4% + F-2.5 ml) than other treatment groups, except those fed higher levels of both urea and formalin in combination (U- 4% + F-20 ml).

Kidney mass showed a significant difference only after the end of the third week, with lower ($P<0.05$) values in birds fed higher level of formalin alone (20 ml) or in combination with higher level of urea (F- 20 ml+ U- 4%) and in those fed a higher level of urea in combination with lower level of formalin (U-4 % + F-2.5 ml) than in the control and other treatment groups (Table 4).

Heart mass after the end of third week showed a non-significant difference between treatment and control group and between treatment groups themselves (Table 4). However, after the end of first week heart mass was lower ($P<0.05$) in birds fed higher levels of urea alone (U- 4%) or in combination with a higher level of formalin (U- 4% + F-20 ml) and those fed higher level of formalin in combination with lower level of urea (F- 20 ml + U-1%) than in the control group. However, after the end of the second week it was higher ($P<0.05$) only in birds fed a higher level of urea (U- 4%) than in the control group.

Proventriculus mass showed a non-significant difference between treatment groups and the control group during the experiment (Table 5). Similarly, gizzard mass showed a non-significant difference at the end of each week, except at the end of second week where it was significantly lower ($P<0.05$) only in birds fed a lower level of urea in combination with higher level of formalin (U-1% + F-20 ml) than in the control and all other treatment groups (Table 5).

*Serum proteins.*Total serum proteins and fibrinogen showed a non-significant difference between treatment groups and the control group during the experiment (Table 6). However, among treatment groups after the end of third week, serum total protein was significantly higher ($P<0.05$) in birds fed a higher level of urea alone than those fed a higher level of formalin (F-20 ml) alone or in combination with higher level of urea (F-20 ml + U-4%).

After the end of first week serum fibrinogen was lower ($P<0.05$) in birds fed a higher level of urea in combination with two levels of formalin and in birds fed higher level of formalin alone than those fed with milder

levels of urea and formalin in combination (U-1 % + F-2.5 ml) (Table 6). After the end of the second week fibrinogen was higher in birds fed higher levels of both urea and formalin in combination with (U-4 % + F-20 ml) than those fed a higher level of formalin in combination with a low level of urea (F- 20 + U-1 %).

Serum albumin after the end of third week showed a non-significant difference between treatment groups and the control group (Table 7). However, among treatment groups it was higher ($P<0.05$) in birds fed a higher level of urea alone than those fed a higher level of formalin in combination with lower level of urea (F-20 ml + U-1 %). After the end of the first week serum albumin was significantly higher ($P<0.05$) in birds fed a higher level of both urea and formalin (U-4% + F-20 ml) and also in those fed a lower level of both urea and formalin in combination (U-1% + F-2.5 ml). The difference between treatment groups and the control group was non-significant after the end of the second week.

Serum globulins after the end of the third week were higher ($P<0.05$) in birds a fed higher level of formalin in combination with low level of urea (F-20 ml + U-1%) than in the control group, while a non-significant difference was observed between treatment groups (Table 7). However, after the end of the second week these levels were lower ($P<0.05$) in birds fed a higher level of urea in combination with a lower level of formalin (U-4% + F-20 ml) than in the control group.

Feed consumed. After the end of third week birds fed higher levels of formalin alone or with lower levels of urea consumed significantly higher amounts of feed than the control group, and also than those fed a milder level of urea and formalin (U-1% + F-20 ml) and a higher level of urea with a lower level of formalin in combination (U-4 % + F-2.5 ml) (Table 8). Those fed milder levels of urea and formalin in combination (U-1% + F-2.5 ml) consumed a significantly higher ($P<0.05$) amount of feed than the control group and other treatment groups. After the end of second week birds fed a higher level of urea along with a lower level of formalin consumed a significantly higher ($P<0.05$) amount of feed than the control group.

Discussion

Previous studies on feeding urea through commercial feed at a level of 1% revealed an increase in both live and carcass mass in broilers (PERVAZ et al., 1994), whereas levels beyond 4% had adverse effects on health and performance (PERVAZ et al., 1994 and 1996; JAVED et al., 1995). Studies on formalin administration through commercial feed at a level of 2.5ml /kg feed revealed non-significant effects on health and performance of broilers, while higher levels beyond 10ml/kg feed revealed a significantly adverse effect on broiler health and performance, including live mass, carcass mass and feed conversion ratio (BABAR, 1997). The slow release of formaldehyde from urea formaldehyde foam used for the insulation of homes in order to conserve heat has shown some serious health concerns in human beings. Combined use of urea, along with formalin-casein in sheep, revealed that protein energy absorbed was greater from the small intestine compared with urea (KEMPTON et al., 1979). Results of the present study in broilers, where formalin was combined with urea with different combinations, showed lowered live mass and carcass mass compared with controls. It is worth mentioning that a non-significant or better performance was observed earlier when these substances were used in isolation at low levels, where combined use at those levels revealed reduced effects as far as growth and other parameters are concerned. This shows that the combined use of these compounds in broilers is of no value and that chickens do not possess the capability to use these compounds in bound form. However, an enzyme from the soil microorganism *Ochrobacterum anthropi* has been identified which metabolizes the urea-formaldehyde into ammonia, urea and formaldehyde (JAHNS et al., 1998). Such a system is probably absent in broilers, but appears to be present in sheep (KEMPTON et al., 1979). However, results of the present study revealed that the effects of these compounds were dose dependent on almost all parameters studied, including live mass carcass mass and organ mass. Feed consumed by broilers as recorded at the third week of the trial was higher in all treatment groups than in the control group, but was greater in birds fed 20 ml formalin alone or with 1% urea, and was low in birds fed higher levels of urea. A previous study on urea in broilers revealed a decrease in feed consumption, particularly at dose levels greater than 4% than in the control group (PERVAZ et al., 1994). The same

was true for the formalin study in broilers (BABAR, 1997). This increase in feed intake during the present study, where urea-formaldehyde in combination was used, could not be explained. In dairy cows, however, formaldehyde-treated soya-bean meal significantly increased the daily intake of feed (HERMANSEN and KRISTENSEN, 1993).

During the present study, a non-significant increase in serum total proteins with a non-significant decrease in serum albumin was observed in almost all treatment groups, while globulins were significantly or relatively higher in treatment groups. It may be possible that non-protein nitrogen in the form of urea and other products, along with globulins, contributed to the relative increase in serum total proteins in treated broilers. OLDHAM et al. (1982) observed an increase in growth hormone in serum in dairy cows fed formaldehyde treated protein with higher serum urea.

It can be concluded from the present study that urea-formaldehyde through feed has no useful effects; rather, at higher levels it has adverse effects on health and performance of broilers when given for a prolonged period of time.

References

ANONYMOUS (1996): SAS release 6.1.2. SAS Institute inc., SAS campus drive., Cary., North Carolina U.S.A. 25513.

BABAR, A. M. (1997): Pathological effect of formalin feeding to broiler chicks. M. Sc., Thesis Dept. Vet. Path. Univ. Agri. Faisalabad, Pakistan.

BENJAMIN, M. M. (1978): Outline of veterinary clinical pathology. 2nd Edition, Iowa state university press, Ames, Iowa, U.S.A.

CHANDRA, M., S. SINGH, P. P. GUPTA, S. P AHUJA (1984): Comparative pathogenesis of nephritis in poultry induced by high protein, high calcium, urea and vit deficient diets. Acta Veterinaria 34, 113-134.

GUO, X. D. (1983): Preliminary observation on urea poisoning in chicken. Chinese J. Vet. Med. 9, 36-37.

HERMANSEN, J. E., T. KRISTENSEN (1993): The effect of supplementary formalin treated soyabean meal on feed intake, milk yield and live weight gain of dairy cows fed ensiled fodder beets. Arch. Tierernähr. 43, 245-250.

HILLER, A., J. PLAZIN, D. D. VAN SLYKE (1948): A study of conditions for Kheldahl determination of nitrogen in proteins. J. Biol. Chem. 176, 1401-1420.

HUSSAIN, R. (1995): Effect of urea feeding on health of broiler and layer chickens. Ph.D Thesis Dept. Vet. Path, Univ. Agri, Faisalabad, Pakistan.

JAVED, M. T., S. PERVAZ, M. A. SABRI, H. A. KHAN, Z. A. CHATTA, M. YOUNIS (1995): Studies on body weight, gross pathology and some serum enzymes of urea induced toxicity in broiler chicks. Pakistan Vet. J. 15, 109-112

JAHNS, T., R. SCHEPP, C. SIERSDORFER, D. H. KALTWASSER (1998): Microbial urea-formaldehyde degradation involves a new enzyme, methylenediurease. Acta Biol. Hung. 49, 449-454.

JABBAR, L. (1994): Pathology of experimentally induced urea toxicity in broiler chicks. M. Sc. Thesis Dept. Vet. Path., Univ. Agri. Faisalabad, Pakistan.

KEMPTON, T. J., J. V. NOLAN, R. A. LENG (1979): Supplementing a low-protein-cellulosic diet with either urea, casein or formaldehyde-treated casein. Br. J. Nutr. 42, 303-315.

KOBAYASHI, S., H. KOIKE, D. H. ITOH (1981): Effects of dietary urea on nitrogen exertion in cockerels. Japanese Poult. Sci. 18, 78-85.

OKUMURA, J. G., D. HEWITT, D. N. SALTER, M. E. COATES (1976): The role of the gut microflora in the utilization of dietary urea by the chick. Brit J. Nutr. 21, 167-180.

OLDHAM, J. D., I. C. HART, J. A. BINES (1982): Formaldehyde-treated proteins for dairy cows - effects on blood hormone concentrations. Br. J. Nutr. 48, 543-547.

OSER, B. L. (1976): Hawks. Physiological chemistry McGraw Hill Pub. Co. New Delhi, India.

PERVAZ, S., M. T. JAVED, S. PERVAIZ (1994): Studies on feed consumption, Live body weight and clinical signs in urea induced toxicity in broiler chicks. Singapur Vet. J. 17, 51-57.

PERVAZ, S., M. T. JAVED, M. A. SABRI, S. PERVAIZ (1996): Haematological and biochemical findings in broilers feed different levels of urea. Pakistan Vet. J. 16, 75-77.

SUCIO, I., V. MICLEA, I. TAT, D. LONZONE (1990): Effects of replacing part of the protein in the diet with urea, in the presence of Volcanic Tuff Zeolite, on the performance of broiler chickens. Buletinal institutului Agronomic Clij Napoea 44, 13-18.

VARLEY, H., A. H. G. OWENLOK, M. BELL (1980): Practical clinical biochemistry. Vol. 1, Williams and Heinmann Medical books Ltd., London, pp. 553-554.

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JAVED, M. T., M. A. SARWAR, R. KAUSAR, I. AHMAD: Učinak hranidbe s dodatkom različitih količina formalina (37% formaldehid) i ureje na zdravlje i proizvodnost tovnih pilića. Vet. arhiv 72, 285-302, 2002.

SAŽETAK

Istra•ivanje je provedeno na 280 tovnih pilića u dobi od 21 dan podijeljenih u sedam skupina. Pilićima je ponuđena hrana s različitim količinama formalina i ureje. Učinak je provjeren nakon tri tjedna i to određivanjem tjelesne mase, mase pilića nakon klanja te mase organa. U pilića hranjenih malim količinama formalina (1%) i ureje (2,5 ml) nisu zabilježene razlike u odnosu na piliće iz kontrolne skupine. Apsolutna masa timusa bila je u svih pokusnih pilića manja osim u onih koji su dobivali 20 ml formalina uz različite količine ureje (1% i 4%). Masa burze bila je u svih skupina manja u odnosu na kontrolnu skupinu. Apsolutna masa slezene bila je značajno manja ($P<0,05$) u pilića hranjenih s dodatkom 1% ureje i 2,5 ml formalina te 4% ureje i 20 ml formalina. Masa jetre i bubrega bila je značajno manja ($P<0,05$) u pilića koji su dobivali 20 ml formalina, kao i u onih koji su dobivali veće količine ureje uz dvije različite količine formalina (ureja 4% + 2,5 ml formalina, ureja 4% + 20 ml formalina) u usporedbi s kontrolnom skupinom. Nije bilo razlika u odnosu na apsolutnu masu srca te mišićnog i žlijezdanog želuca. životinje koje su dobivale samo 20 ml formalina ili 1% ureje uzimale su veću količinu hrane. Nisu utvrđene značajne razlike u odnosu na količinu ukupnih proteina, albumina i fibrinogena u krvi. U ptica koje su uzimale 1% ureje i 20 ml formalina utvrđene su značajne razlike u količini serumskih globulina u odnosu na kontrolnu skupinu.

Ključne riječi: ureja, formalin, tjelesna masa, masa nakon klanja, masa organa, serum, proteini, tovni pilići