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Yield, Carcass and Sensory Characteristics of Broiler Meat after Withdrawal of Anticoccidial Semduramicin from Feed

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Abstract: With (25 mg kg⁻¹ feed) or without semduramicin (coccidiostat) containing feeds were offered for 35 days to 160 (2 treatmentsX10 replicatesX8 birds/replicate) newly hatched female broiler chicks to know the effect of semduramicin on growth performance as well as carcass and sensory characteristics of meat after 5 to 8 days withdrawal of semduramicin. Diets were offered to the birds formulated based on soybean meal, corn and soybean oil. Blood parameters, enzyme profiles and health status were studied from selected birds at the end of the growth trial. Twenty birds (2 per replicate) of each feeding groups were transferred into floor pens and offered only the control diet. Five broilers from each feeding group (control and withdrawal) were slaughtered at day 5, 6, 7 and 8. Body weight (and feed conversion efficiency-FCE; g gain kg⁻¹ feed) after 35 days feeding trial was 2,062 (665) and 2,084 (678) for the control and semduramicin group (p>0.05), respectively. Feed intake (3,018 vs 2,996 g) was also similar (p>0.05) in both groups. Blood parameters, enzyme profiles and pathological study did not give evidence for any adverse influence of semduramicin. The semduramicin group had slightly higher body weight (2,569 vs. 2,477 g; P>0.05) at slaughter after 5-8 days withdrawal. Nevertheless, there were no treatment effects (P>0.05) on hot carcass weight, viscera (g or % of bw), dressing percentage, edible portions (breast muscles, haunch), fat and skin portions. Also the sensory characteristics (juiciness, tenderness, aroma, general impression) were not influenced by the treatment. However, the aroma/flavour of carcass in the semduramicin group was improved (P<0.05), probably due to a slightly higher intramuscularly fat content in meat (P<0.05).

Key words: Broiler meet, Anticoccidial Semduramicin, priteins

Introduction

Coccidiosis, a debilitating protozoal (*Eimeria* spp.) infection in poultry, is prevented by the wide spread use of coccidiostats as feed additive. Among coccidiostats semduramicin (molecular formula of the sodium salt: C₄₅H₇₅O₁₆Na and weight: 894.5.) is a monocarboxylic acid polyether ionophore produced by fermentation of a selected strain of *Actinomadura roseorufa* (Glazer *et al.*, 1992) and which had a broad spectrum of anticoccidial activity against *Eimeria* spp. at inclusion levels in the feed ranging from 20 to 30mg kg⁻¹ feed (Ricketts *et al.*, 1992). But optimum dose level for maximum weight gain and control of coccidial lesions in broiler chicks was confirmed to be 25 mg kg⁻¹ feed (Conway *et al.*, 1993; McKenzie *et al.*, 1993; SCAN, 2002).

The effects of semduramicin on growth and processing parameters in broiler chicken are small, but considerable benefits in performance and carcass parameters could be realized by feeding higher levels of protein or methionine (Pesti *et al.*, 1999a and 1999b). It is also recognized that the birds after withdrawal of semduramicin minimize the residue in edible part below the safety level. Different report suggested 3 to 5 days withdrawal of semduramicin to reduce residual content

in the carcass. But, most of the study conducted after inoculums of *Eimeria* spp. and a limited work as routine inclusion for prevention of coccidian. Safety margin was studied based on the residual content in edible part, but carcass characteristics after withdrawal were not studied. So, our study designed to know the effect of semduramicin on growth and health status as well as its withdrawal on the carcass characteristics of broiler.

Materials and Methods

The feeding trial was conducted for a period of 35 days in 2003 in the battery house of Veterinary Medicine Faculty, University of Leipzig, Germany and a subsequent 5-8 days short trial conducted at the floor pen of the Institute of Animal Nutrition, Nutrition Diseases and Dietetics of same university.

Experimental design: A number of 160 Lohmann-Hybrid day old female broiler chicks were randomly distributed in 20 cages (among a total number of 72) considering 8 birds in each. Birds in 10 cages offered corn and soybean based pelleted diets (Table 1) and other 10 cages offered the feed containing 25 mg kg⁻¹ semduramicin.

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Table 1: Formulation of rations (%) and their chemical composition (g/100g air dry sample)

Code	(1)	(2)	Code	(1)	(2)
Semduramicin; (mg kg ⁻¹ feed)	-	25	Semduramicin	-	25
Ingredients			Composition		
Soybean meal	46.000	46.000	Dry matter	94.22	93.69
Corn	39.700	39.700	Crude protein	24.62	24.28
Soybean oil	7.500	7.500	Crude fibre	4.85	4.73
Wheat starch (cooked)	2.000	1.950	Ether extract	12.04	11.60
¹ AVIAX (semduramicin)	-	0.050	Ash	7.50	7.08
Calcium propionate	1.000	1.000	Nitrogen free extract	45.21	46.00
Monocalcium phosphate	1.450	1.450	Organic matter	86.72	86.61
Calcium carbonate	1.350	1.350	Starch	17.37	24.60
Sodium chloride	0.465	0.465	Sugar	5.37	4.64
Vitamin premix ^a	0.250	0.250	Methionin	0.44	0.45
Trace element premix ^b	0.125	0.125	Cystine	0.40	0.42
DL-methionine	0.160	0.160	*ME (MJ/Kg)	11.55	12.46
Total	100	100	² Semduramicin(mg/kg)	<1	25.45

¹To prepare the semduramicin blend; 0.05% wheat starch was replaced by the same amount of AVIAX-premix (45% semduramicin).

²Analysed by the Institute Européen de l'Environnement de Bordeaux (I.E.E.B.), Direction Agroalimentaire, 1 Rue du Professeur Vezes, F-33300 Bordeaux, France.

*Calculated from FMV (ME in MJ/kg = g Crude protein x 0.01551 + g Crude Fat x 0.03431 + g Starch x 0.01669 + g Total sugar x 0.01301) according to Weinreich *et al.*, 2002.

^aVitamin premix (2.5g): Vitamin A 13,500 I.U; alpha DL-Tocopherol acetate 50 mg; Vitamin D₃ 1,500 I.U; Thiamine 3 mg; Pyridoxine 4 mg; Biotin 250 µg; Nicotinic acid 60 mg; Choline (from choline chloride) 750 mg; Menadione 2 mg; Riboflavin 5 mg; Cobalamin 15 µg; Folic acid 200 µg; Calcium pantothenate 30 mg; Ascorbic acid 150 mg.

^bTrace element premix (1.25g): Fe 125.00mg; Cu 10.00mg; Se 0.25mg; Co 0.20mg; Zn 100.00mg; Mn 50.00 mg and I 2.50mg.

Growth trial: Each 8 birds were provided 0.8m² (100cm x 80cm x 60cm pen) floor space. Temperature of the trial house was maintained at 33°C from the beginning and reduced 2.7°C per week until 26°C. Both temperature and ventilation were controlled automatically in a continuous flow by one side of the house. Feces were removed frequently from the tray. Light was provided continuously. Birds were vaccinated against 'Gumburo' and 'Infectious Bursal Disease' in the hatchery and against 'New Castle Disease' via drinking water at 8th day of the trial. Feeds and water were offered on ad libitum basis. Birds were weighed per week. Feed supply, refusal and wastage were recorded.

Blood parameter and necropsy: At the end of the trial blood samples were collected from Vena cutanea ulnaris in view of know the protein, albumin, glucose, uric acid, electrolytes, blood cells and enzymes from 20 birds (1 per cage those near to mean cage weight). Then the birds were killed (blow the head decapitation) for a general pathological examination and necropsy.

Semduramicin withdrawal trial: Forty birds (2 from each cages those weight near to cage average) were selected, marked and transferred to floor pen. Each pen has a surface of 2.33m² (2.45mx0.95mx1.00m) for 4 animals per pen. Wood shavings were used as bedding material. Birds were offered only the control diet for both groups until slaughter.

Slaughtering, processing, cooking and panel test:

Every day 5 birds (1 per pen) were slaughtered from day 5th to 8th of withdrawal period. The combined weight of head and neck was recorded before plucking the slaughtered birds. The weight of shanks, whole viscera and heart, liver, muscle, stomach and hot carcass were determined after wet plucking. Carcass, shanks and the giblets (heart, liver, gizzard) were kept at 4°C for further weighing. After overnight cooling again all parts were weighed. Then, the portions of breast (skin, small and large muscle), leg (skin, muscle, bone, fat) and wings were weighed. Breast and thigh muscles were cooked and broiled to evaluate by a panel consisting 4 trained persons for sensory characteristics.

Chemical and data analysis: Proximate components of feed were determined according to VDLUFA (2000) and starch as well as total sugars were analyzed using starch gelatinization and hydrolysis method, which was modification from enzymatic technique (Holm *et al.*, 1986). Protein and fat content in breast muscle of selected birds were analyzed at the mentioned LUFA-laboratory. Data were analyzed for analysis of variance (ANOVA) and group differences (Tukey's B test) according to Steel and Torrie (1960). Student-t test conducted to know the variation of carcass characteristics between two groups.

Table 2: Growth, feed intake and feed conversion efficiency (gLWG/1000 g FI) of broilers during 35 days growth trial and growth during withdrawal period

Code	(1)	(2)
Semduramicin (mg kg ⁻¹ feed); Day 1-35	None	25
Initial, (±sd)	54 (0.2)	54 (0.5)
Relative to (1)	100	100
Final LW, (± sd)	2062 (89)	2084 (58)
Relative to (1)	100	101
Total LWG, (± sd)	2008 (89)	2030 (58)
Relative to (1)	100	101
Total FI, (± sd)	3018 (69)	2996 (117)
Relative to (1)	100	99
FCE (Initial - 35 day), (± sd)	665 (20)	678 (19)
Relative to (1)	100	102
FCR (Initial-35day), (± sd)	1.59 (0.05)	1.48 (0.04)
Relative to (1)	100	98
Mortality (%)	8.75	5.0
(No. of died birds/treatment)	(7)	(4)
Semduramicin (mg kg ⁻¹ feed); Day 36-43	None	None
LW (selected birds at day 35), (± sd)	2085 (112)	2114 (62)
Relative to (1)	100	101
LW (during slaughter), (± sd)	2477 (178)	2569 (168)
Relative to (1)	100	104
LWG (day 35 to slaughter), (± sd)	60 (9)	70 (10)
Relative to (1)	100	116

NB; All the parameters showed insignificant differences at 5 % level of significance; FCR- Feed intake per unit weight gain

Results and Discussion

Growth performance: Mean weight of day old birds was 54g and gained 2008 and 2030g respectively in control and semduramicin group ($p>0.05$) after 35 days trial (Table 2). Total feed intake also similar in both groups showed 3018 and 2996g in control and semduramicin groups ($p>0.05$), respectively. Logically the feed conversion efficiency (g LWG/1000g FI) was similar ($p>0.05$) in control (665g) and semduramicin (678g) groups. This finding supported by Pesti *et al.*, 1999b, found that the 25 mg kg⁻¹ feed in broiler from 18-35 day did not depress weight gain, feed intake as well as feed conversion ratio when the protein level was optimum. But, McDougald *et al.*, 1996, found better performance and improved lesion control due to inclusion of semduramicin in comparison with other anticoccidial. Inverse result comes out because they worked on coccidian challenge condition instead of routine inclusion, so treatment and lesion control caused improvement in treatment group than control (Ricketts *et al.*, 1992). At the end of extended fattening period broiler of the semduramicin withdrawal group showed a slightly higher final body weight than the birds of the control (2569 vs 2477g, $P>0.05$). During withdrawal the weight gain improved numerically (70 vs 60g in semduramicin and control), which is supported by the observations of Pesti *et al.*, 2002. The authors reared broilers for a period of 49 days under non-(coccidian) challenge conditions and obtained best performance with a 10 days withdrawal.

Mortality of birds: Control and semduramicin group caused respectively 8.75 and 5.0% bird mortality. Reasons were mainly acute cardiovascular failure (myocarditis, fibrosis or degeneration of myocard) and disorders of the muscles or bones (myopathy, myositis, osteochondrosis), both frequent causes for commercial broiler fattening because the faster growing broilers are not capable to grow their heart according to other organs, so ultimately relative size of the broiler having higher body weight is lower (Olkowski, 2004).

Blood profile and necropsy: Different constraints of blood plasma (protein, albumin, glucose, uric acid, sodium, chloride and potassium), enzymes (creatinase kinase, alkaline phosphatase, lactate dehydrogenase, aspartate aminotransferase, γ -glutamyl transferase and alanine aminotransferase) and blood parameters (haematocrit, erythrocytes, leucocytes, heterophils, lymphocytes, basophils, eosinophils and monocytes) seems to be somewhat inconsistent concerning trend and extent of the observed alteration (data not shown). The observed differences was not significant can obviously not be attributed to the treatment. The pathological-anatomical (macroscopical) examination also revealed no specific findings. In some birds acute haemorrhages of obviously traumatic origin were found, which however might be attributed to the handling of the birds or to manipulations during blood sampling. Most of the findings for pathological - histological (light-

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Table 3: Slaughtered birds and their different parts (g and % of live) immediately after slaughtering

Code		(1)	(2)	(1)	(2)
Semduramicin (mg kg ⁻¹ feed)	Day 1-35	None	25	None	None
	Day 36-43	None	None	None	None
		Weight (g)		Weight (% of LW)	
Hot carcass (eviscerated), (± sd)		1868 (164)	1951 (154)	75.4 (2.4)	75.9 (2.0)
Relative to (1)		100	104	100	101
Shanks, (± sd)		82.4 (8.6)	84.6 (4.5)	3.33 (0.28)	3.30 (0.22)
Relative to (1)		100	103	100	99
Head and neck, (± sd)		118 (22)	122 (21)	4.79 (0.93)	4.78 (0.84)
Relative to (1)		100	104	100	100
¹ Viscera, (± sd)		277 (29)	277 (30)	11.21 (1.18)	10.79 (0.91)
Relative to (1)		100	100	100	96
*Liver, (± sd)		55.9 (10.1)	54.8 (8.8)	2.26 (0.37)	2.13 (0.28)
Relative to (1)		100	98	100	94
Heart, (± sd)		10.4 (1.4)	10.9 (1.0)	0.42 (0.05)	0.42 (0.05)
Relative to (1)		100	105	100	101
Gizzard, (± sd)		21.0 (3.2)	19.7 (2.7)	0.85 ^a (0.14)	0.77 ^b (0.10)
Relative to (1)		100	94	100	90

*Without gallbladder. ¹Viscera: stomach, intestine, liver, spleen, lung and heart. ^{ab}Values with different superscript in the same parameter in same row are different (P<0.05)

Table 4: Weight (g) of slaughtered bird and their different parts after overnight cooling (4°C)

Code		(1)	(2)	(1)	(2)
Semduramicin (mg kg ⁻¹ feed)	Day 1-35	None	25	None	25
	Day 36-43	None	None	None	None
		Weight (g)		Weight (% of LW)	
Carcass (eviscerated), (± sd)		1848.0 (162)	1931.0 (152)	74.6 (2.4)	75.1 (2.0)
Relative to (1)		100	104	100	101
Shanks, (± sd)		82.1 (8.6)	84.3 (4.5)	3.32 (0.28)	3.29 (0.22)
Relative to (1)		100	103	100	99
*Liver, (± sd)		55.0 (9.8)	53.4 (8.1)	2.22 (0.36)	2.07 (0.25)
Relative to (1)		100	97	100	93
Heart, (± sd)		10.3 (1.4)	10.8 (0.9)	0.42 (0.05)	0.42 (0.04)
Relative to (1)		100	104	100	100
Gizzard, (± sd)		20.4 (3.0)	19.4 (2.5)	0.83 ^a (0.1)	0.76 ^b (0.1)
Relative to (1)		100	95	100	91
Abdominal fat, (± sd)		30.4 (11.4)	30.4 (11.3)	1.23 (0.48)	1.18 (0.44)
Relative to (1)		100	100	100	96

*Without gallbladder; ^{ab}Values with different superscript in the same row are different (P<0.05)

microscopical) examinations could not be attributed to the semduramicin administration (also data not shown). Our findings supported observation of Elizabeth and Illyes, 1994, whose stated absence of any clinical signs and mortality due to semduramicin medicated feed in broiler. Also there were no haematological abnormalities, no gross pathological or histopathological abnormalities in their observation. In crumble feeding study also showed earlier the same result in broiler (Logan, 1994a). Other researcher also proved the absence of any pathological affect on turkey and horse (Logan, 1994b) due to addition of semduramicin in feed even though more than recommended level.

Carcass characteristics: Weight gain was about 16 % higher in the semduramicin group during withdrawal; also the higher hot carcass weight of the semduramicin birds (+4%; P>0.05) reflects completely the higher final weight. Nevertheless, a significant effect (P>0.05) of the former dietary treatments on the main slaughter characteristics (Table 3) determined immediately after slaughtering (without cooling) could not be observed, neither for the absolute nor for the percentage figures; only gizzard related to LW (%) was significantly (P<0.05) lower in the withdrawal group, which should not be a relevant finding because of the low absolute weight of the gizzard. However, in the withdrawal group also a tendency to lower liver weight related to LW is evident.

Table 5: Weight (g) of different parts and fraction of slaughtered bird after overnight cooling (4°C)

Code		(1)	(2)	(1)	(2)
Semduramicin (mg kg ⁻¹ feed)	Day 1-35	None	25	None	25
	Day 36-43	None	None	None	None
		Weight (g)		Weight (% of LW)	
Brest, total, (± sd)		512.6 (52.5)	546.3 (57.8)	26.5 (1.2)	27.1 (1.9)
Relative to (1)		100	107	100	102
skin (g), (± sd)		51.6 (7.3)	51.2 (8.2)	2.7 (0.4)	2.5 (0.4)
Relative to (1)		100	99	100	95
small muscle (g), (± sd)		87.9 (11.8)	95.2 (12.6)	4.5 (0.4)	4.7 (0.4)
Relative to (1)		100	108	100	104
large muscle (g), (±sd)		373.1 (42.2)	399.9 (44.2)	19.3 (1.0)	19.8 (1.5)
Relative to (1)		100	107	100	103
total breast muscle (g), (± sd)		460.9 ^a (51.1)	495.1 ^b (54.4)	23.8 (1.1)	24.6 (1.8)
Relative to (1)		100	107	100	103
Legs and thighs, total (g), (± sd)		533.5 (45.8)	556.9 (51.3)	27.6 (1.8)	27.7 (1.6)
Relative to (1)		100	104	100	100
skin, (± sd)		68.7 (8.0)	71.7 (9.9)	3.6 (0.4)	3.6 (0.4)
Relative to (1)		100	104	100	100
fat, (± sd)		17.0 (6.3)	18.8 (6.8)	0.9 (0.3)	0.9 (0.3)
Relative to (1)		100	111	100	100
bone, (± sd)		89.6 (12.4)	90.9 (11.2)	4.6 (0.6)	4.5 (0.5)
Relative to (1)		100	101	100	97
muscle, (± sd)		356.8 (34.6)	375.0 (39.4)	18.5 (1.4)	18.6 (1.3)
Relative to (1)		100	105	100	101
Muscle (breast+legs+thighs),(g),(± sd)		817.8 ^a (77.7)	870.1 ^b (84.0)	42.3 (1.8)	43.2 (2.2)
Relative to (1)		100	106	100	102
Wings, (± sd)		181.7 (18.5)	188.2 (12.9)	9.4 (0.6)	9.4 (0.5)
Relative to (1)		100	104	100	100

*Without gallbladder. ^{ab}Values with different superscript in the same row are different (P<0.05)

Table 6: Chemical composition (g/100 g fresh matter) of breast muscle meat from the carcass after overnight chilling

Code		(1)	(2)
Semduramicin (mg kg ⁻¹ feed)	Day 1-35	None	25
	Day 36-43	None	None
Crude protein, (± sd)		23.1 (± 0.8)	23.4 (± 0.4)
Relative to (1)		100	102
Crude fat, (± sd)		1.57 ^a (± 0.61)	2.01 ^b (± 0.60)
Relative to (1)		100	135

^{ab}Values with different superscript in the same row are different (P<0.05)

After an overnight cooling almost similar results were obtained as for the fresh material (Table 4). However, as expected in both treatment groups carcass weight, dressing percentage and weight of liver, heart and gizzard was somewhat lower after overnight storage, because of dripping off losses.

The carcass parts (Table 5) given as absolute and relative figures (% of eviscerated carcass with giblets) for breasts, legs and wings with the corresponding portions of skin, muscle and fat are presented. According to LW at slaughter weight of breast, legs and wings was higher in the withdrawal birds, nevertheless, significant differences (P<0.05) between control and withdrawal group could only be observed for total breast muscle (460.9 vs 495.1g;+7%) and total muscles of

breast, legs and thighs (817.8 vs 870.1g; + 6%). However, differences between treatment groups considerably decrease when carcass traits were related to eviscerated carcass (2-3%;P>0.05). McDougald *et al.*, 1996, used semduramicin (25 mg kg⁻¹ feed) in broiler resulted best in shank pigmentation than other anticoccidials, which might be due to better medicinal value on the coccidial challenge birds but not on the control. Whereas we did not use it on coccidial challenge condition, so its effect on the shank pigmentation was not evident.

Chemical composition of edible parts of carcass: Although the intra-muscular fat content in the meat of the semduramicin fed broilers was significantly higher

Table 7: Sensory Characteristics of Broiler meat (after overnight cooling at 4°C)

Code	(1)	(2)	Code	(1)	(2)
Carcass eviscerated	1933.8	2014.5	Aroma/flavour	4.0 ^a	4.5 ^b
(±sd)	(166)	(157)	(±sd)	(0.6)	(0.8)
Relative to (1)	100	104	Relative to (1)	100	112
Dressing percentage	78.0	78.4	General impression	4.5	4.7
(± sd)	(2.3)	(1.9)	(± sd)	(0.4)	(0.5)
Relative to (1)	100	100	Relative to (1)	100	106
Juiciness	5.0	5.1	Unpleasant flavour	3.0	3.0
(± sd)	(0.5)	(0.4)	(± sd)	(0.0)	(0.0)
Relative to (1)	100	101	Relative to (1)	100	100
Tenderness	5.1	5.2			
(± sd)	(0.5)	(0.5)			
Relative to (1)	100	102			

Scoring scheme:

Criteria	6	5	4	3	2	1
Juiciness	Very juicy	Juicy	A little juice	A little dry	Dry	Very dry
Tenderness	Very tender	Tender	A little tender	A little tough	Tough	Very tough
Aroma/flavour	Excellent	Very good	Good	Satisfactory	Sufficient	Not sufficient
General Impression	Excellent	Very good	Good	Satisfactory	Sufficient	Inadequate
Unpleasant flavour	-----	-----	-----	None	A little	Strong

^{a,b}Values with different superscripts in the same row are different (P<0.05).

(P<0.05) than in control, absolute group differences were small. Moreover the low absolute values were accompanied by high standard deviations (Table 6). From this point of view the results should not be overestimated. The crude protein content did not differ between treatment groups.

Sensory characteristics: The absence of unpleasant, pungent flavour and the sensory characteristics of the slaughtered birds could be assessed as very good, independent of the treatment (Table 7). The aroma and flavour of the withdrawal broilers was evidently more favourable (P<0.05) and there was also a tendency to an improvement (P<0.10) of the general impression, whereas juiciness and tenderness were not influenced. Although an unpleasant pungent flavour could not be observed in any case, in 7 broilers of the control group and 6 broilers of the withdrawal group a slightly sour aroma was identified by some panel members. Both findings may be a result of the slightly higher (2.01 vs. 1.57 %) intra-muscular fat content (Table 6) in the breast muscle of the semduramicin birds.

Also in 3 birds of control and 5 chicks of semduramicin group a metallic group or tasteless (1 bird of semduramicin group) aroma was detected. It seems that the unpleasant taste affected only in case of the semduramicin birds the scores for aroma/flavor, because the affected broilers (n=9) of the control and semduramicin group (n=8) had an average aroma/flavor score of 4.0±0.4 and 4.0±0.9 respectively. Therefore semduramicin fulfils the requirements of EU regulations (Regulation 1831/2003) that a feed additive should not affect production (chemical, organoleptic and sensory) quality. Its withdrawal also increased aromatic flavor of meat slaughtered after 5-8 days withdrawal.

So, anticoccidial semduramicin might be recommended

for routine inclusion in broiler diet throughout the period with 5 days withdrawal before slaughter, because it does not cause any adverse effect on the production parameters and health status. Carcass and its different portions of semduramicin group found insignificant weight loss after overnight chilling. Furthermore its withdrawal increased consumer acceptability of cooked and broiled meat through the development of aromatic flavor.

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