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Effect of Acidified Sodium Chlorite Treatment of Feedstuffs on Nitrogen and Amino Acid Digestibility in Poultry

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ABSTRACT

The present study was conducted to study the effect of Acidified sodium chlorite (ASC) treatment on nitrogen utilization and amino acid digestibility in caecectomised white leghorn cockerels. Feed ingredients viz. soybean meal, meat cum bone meal and sunflower meal were treated with 80 ppm of ASC either in dry or wet form and 30 g of these ingredients were forced fed to caecectomised white leghorn cockerels, maintained in individual cages. Fecal material was collected (up to 24 h) and analyzed for dry matter, nitrogen, uric acid and amino acid content. Results revealed that ASC treatment of feedstuffs numerically improved their dry matter metabolizability without any appreciable variation in nitrogen and amino acids bioavailability. Thus it may be concluded that ASC treatment (80 ppm) of feedstuffs has no apparent effect on nitrogen and amino acid digestibility in poultry.

Keywords: ASC, nitrogen, amino Acid, digestibility, cockerel

Acidified sodium chlorite (ASC) has strong biocidal and lignolytic properties and treatment of feedstuffs like sunflower cake, deoiled rice bran and maize-soy mixture with ASC has been found to increase dry matter metabolisability and available energy content in poultry (Thakur *et al*. 2013). Also ASC treatment reduces microbial load and improves energy bioavailability from feedstuffs commonly used in poultry feed (Thakur *et al*. 2014). However, being oxidative in nature and its reported tendency to interact with amino acids (Tan *et al*. 1987) in feedstuffs, its effect on nitrogen utilization and amino acid digestibility in poultry is yet to be explored. Thus the aim of this research was to determine the effect of ASC treatment on nitrogen utilization and amino acid bioavailability from feedstuffs like soybean meal (SBM), meat cum bone meal (MBM) and sunflower meal (SFM), the commonly used sources of protein/ amino acids in poultry feed.

MATERIALS AND METHODS

Acidified sodium chlorite (ASC) was prepared by adding citric acid (Powder form, Himedia) to the known concentration of sodium chlorite (80%, SD Fine Chem. Ltd.) previously dissolved in distilled water to attain a pH of 3.5. The solution so prepared was kept as stock and diluted in water immediately before use. Different feed ingredients viz. SBM, MBM and SFM were thoroughly mixed with ASC (at the rate of 80 ppm) either in dry (moisture 10 g/kg) or wet form (moisture 100g/ kg) for 24 hours, and then dried to uniform moisture

level equal to that of normal/control ingredients. The experiment was carried out using adult Single Comb White Leghorn Cockerels (n= 18), weighing between 1.60 and 1.75 kg, caecectomised as described by Green *et al.* (1987) with slight modifications. The amino acid bioavailability bioassay was conducted as per Sibbald's (1979) crop intubation method. The cockerels were divided into three groups each comprising of six replicated birds. The birds were housed individually in metabolic cages, fed commercial grower mash (165 g/kg CP, 2623 kcal/ME/kg) and fresh, clean drinking water was made available during the adaptation period. All the birds were starved for 48 h and then each cockerel in the first group (control) was forced-fed 30 g of cold pelleted normal feed ingredients (MBM, SBM or SFM), while the second and third group received cold pelleted ingredient treated with ASC (80 ppm) in dry or wet form, respectively. After feeding, the birds were again placed in individual metabolic cages fitted with excreta collecting trays previously covered with polythene sheets. The excreta voided were collected at eight h intervals (thrice daily) for next 24 h. The excreta of each group were pooled into a single sample for analysis. To determine the endogenous losses of nitrogen and amino acids another bioassay was carried out in which the same cockerels were fed a protein free diet as described by Green *et al.* (1987) with slight modifications.

The amassed excreta samples of protein free diet fed cockerels and pooled excreta of starved birds collected during the study were analyzed in triplicate for estimation of endogenous losses of nitrogen and various amino acids and for determination of losses of dry matter, nitrogen, uric acid and amino acids. Similarly the excreta voided for the next 24 h by the birds fed the test ingredients (control as well as ASC treated) were also analyzed for dry matter, uric acid, nitrogen and amino acids content as per standard procedures (AOAC, 1990). The data so collected was analyzed using analysis of variance as per Snedecor and Cochran (1989).

RESULTS AND DISCUSSIONS

The chemical composition of feed ingredients viz. MBM, SBM and SFM (Table 1) was found well comparable to the values reported in literature. In case of amino acid composition (% crude protein) apparent variations were observed like the value for threonine, lysine, methionine and argninine in SBM were found to be lower compared to Vasan (2006), but for SFM and MBM the values were similar.

Dry matter metabolizability and nitrogen digestibility

The effect of ASC treatment of feedstuffs viz. MBM, SBM and SFM on dry matter metabolizability (DMM) as presented in Table 2, revealed that the DMM of MBM, SBM and SFM was improved upon both dry and wet ASC treatment. In case of MBM both dry and wet ASC treatment produced almost comparable improvement *i.e.* 5.37 and 5.20% respectively, over control. In case of SBM, wet treatment produced an 11.51% improvement and was much more effective than dry treatment which yielded only a 1.46% improvement. On the other hand, for SFM dry treatment proved to be more effective as it produced 4.76% improvement in contrast to only 0.51% by wet treatment compared to control samples. The effect of either treatment on apparent and true nitrogen digestibility (Table 2) was comparable and the values for treated samples did not differ significantly from their control counterparts. The improvement in DMM was in close agreement with previous reports like Ibrahim and Pearse, (1983) observed an improvement in *in-vitro* organic matter digestibility of sunflower hulls when treated with sodium chlorite.

Table 1. Chemical composition of feed ingredients

	Meat cum bone meal	Soybean meal	Sunflower meal
Dry matter (%)	93.53	92.06	92.19
Crude protein (%)	54.45	48.28	30.37
Gross energy (Kcal/g)	4.08	4.28	4.28
Crude fibre (%)	NA	6.85	27.65
Total ash (%)	2.64	7.15	2.15
Nitrogen free extract (%)	2.14	32.84	32.15
Calcium (%)	9.35	0.37	1.18
Total phosphorus (%)	6.16	0.75	1.28
Zinc (mg/Kg)	NA	44	65
Cu(mg/Kg)	NA	13	6
Threonine (%)	1.36	1.88	1.11
Methionine (%)	0.65	0.71	0.69
Lysine (%)	2.75	2.82	1.11
Arginine (%)	3.89	3.49	2.42

Table 2. Effect of ASC treatment on dry matter metabolizability (%), apparent and true nitrogen digestibility (%)

Ingredient		DMM	App N dig	True N dig
MBM	Control	51.17	77.01	89.77
	Dry	53.92	76.16	88.92
	Wet	53.83	74.28	87.04
	SEM	1.51	1.23	1.23
SBM	Control	36.93	73.51	86.44
	Dry	37.47	71.87	84.80
	Wet	41.18	73.61	85.54
	SEM	1.10	1.39	1.39
SFM	Control	19.59	68.74	86.70
	Dry	20.57	69.32	87.28
	Wet	19.69	69.76	87.72
	SEM	0.76	2.00	2.00
Probability		NS	NS	NS

NS-non significant.

Table 3. Effect of ASC treatment on apparent and true amino acid digestibility (%)

Ingredient		Threonine		Methionine		Lysine		Arginine	
		Apparent	True	Apparent	True	Apparent	True	Apparent	True
MBM	Control	75.9	82.2	79.4	82.0	81.8	84.0	85.5	87.1
	Dry	76.3	82.5	79.2	81.9	82.1	84.3	86.8	88.4
	Wet	77.9	84.1	78.2	80.9	81.2	83.5	85.57	87.2
	SEM	0.76	0.76	0.69	0.68	0.59	0.59	0.47	0.47
SBM	Control	82.5	87.9	91.3	94.1	87.9	89.8	90.9	92.6
	Dry	82.6	88.0	90.9	93.8	87.8	89.7	90.8	92.4
	Wet	83.7	89.1	91.2	94.1	88.3	90.2	90.9	92.6
	SEM	0.31	0.31	0.14	0.14	0.19	0.20	0.14	0.14
SFM	Control	72.1	81.8	89.4	92.1	74.6	79.7	84.4	86.9
	Dry	72.4	82.1	89.2	91.9	74.9	79.9	84.6	87.2
	Wet	72.1	81.8	88.9	91.7	74.7	79.7	84.4	86.9
	SEM	0.26	0.27	0.11	0.11	0.24	0.24	0.15	0.15
Probability		NS	NS	NS	NS	NS	NS	NS	NS

NS- non significant.

Similarly Reeves, (1987) observed that sodium chlorite treatment of various feedstuffs improved their acid detergent fibre, neutral detergent fibre and hemicelluloses digestibility. Comparable effectiveness of dry and wet ASC treatment in case of MBM but difference in case of SBM and SFM is difficult to explain but may be partly because of feed particle size, which was fine enabling thorough mixing in case of MBM but larger and protected with cell wall in case of SBM and SFM. Variation in composition of feed and their chemical linkages may have also contributed to it. The effect of either treatment on apparent and true nitrogen digestibility was comparable and the values for treated samples did not differ significantly from control samples indicating nitrogen utilization was not influenced by ASC treatment in either form.

Amino acid digestibility

The effect of ASC treatment on apparent and true digestibilities of amino acids threonine, methionine, lysine and arginine from MBM, SBM and SFM in caecectomized cockerels is presented in Table 3. The digestibility values observed in the present study correlates well with those reported by various workers viz Adedokun *et al.* (2009) and Lemme *et al.* (2004). Though ASC treatment in wet or dry form did not produce any significant variation in digestibility of amino acids studied, some numerical variations were evident. In MBM, dry and wet ASC treatment produced 0.5 and 2.5% improvement, respectively, in apparent threonine digestibility over control (75.92%) but wet treatment produced 1.5% reduction in apparent methionine digestibility compared to untreated (79.35%). Almost similar was the trend for true amino acid digestibility as wet ASC treatment (80 ppm) increased threonine digestibility (2.3%) while methionine digestibility was reduced (1.3%) over untreated control. The digestibility values for lysine and arginine in MBM were almost comparable. In SBM, wet ASC treatment produced a 1.43% increase in apparent digestibility of threonine (control 82.5%), similarly the true threonine digestibility was also increased by wet ASC treatment by 1.3% over un-control (87.91%). The digestibility values, both apparent and true, were nearly equal for all the amino acid analyzed in SFM though some small improvement was evident in group provided feed treated with ASC in dry form except for methionine.

The improvement in threonine digestibility in part might be due to improvement in DMM of the feedstuffs, which in turn enabled greater amino acid uptake from intestine. As wet treatment was relatively more effective, reconstitution of feed ingredients by higher moisture could have also contributed. The digestibility values in case of lysine and arginine, were not influenced by ASC treatment. On the other hand a small statistically non significant reduction in methionine digestibility was observed for nearly all the feedstuffs tested, indicating ASC had a tendency to interact with methionine and in turn rendering it less bioavailable. The reduction might be induced by the action of chlorous acid, active component of ASC, on the readily oxidisable functional group in methionine rendering it unavailable for absorption. Chlorine dioxide, which has oxidizing properties similar to ASC, has also been reported to react with amino acids especially those that contain sulphur in their structure (Tan *et al.* 1987). Also it has been found to convert methionine into a form that is not utilized by bacteria. The results suggest that treatment of feedstuffs with ASC (80 ppm) causes only a numerical improvement in the dry matter metabolizability without affecting nitrogen or amino acids bioavailability in adult white leghorn chickens.

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