The nutritional value of poultry litter for ruminants

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Abstract:

Urea is not necessary in the diet ruminant animals, but because of the ruminant unique ability to utilize the nitrogen from urea to form high quality microbial protein, therefore, urea can be fed as a replacement for part of the protein in a ration. Urea, a non protein nitrogen compound, is used by the bacteria in the rumen of the cattle, sheep, goats and camels during the normal fermentation process, urea is broken down to ammonia. The rumen micro-organism is combine the ammonia with products of carbohydrate metabolism to form amino acid content to protein available to the animal when the principle source of dietary nitrogen is intact protein. Manure is an inevitable byproduct of the production of milk, however, Poultry manure is the organic waste material from poultry consisting of animal feces and urine. Poultry litter refers to the manure mixed with some of the bedding material or litter (wood shavings or sawdust) and feathers. The most common source of poultry litter is from broiler houses, poultry manure is inevitable byproduct of the product of poultry meat and eggs, and also as a source of non-protein nitrogen (NPN). Poultry litter is high in nitrogen content. This material shows promise as a feed for ruminant animals. ration containing chicken litter as a supplemental nitrogen source as when fed soybean meal and better than when fed ammoniated molasses. The chicken litter contained 4.85 percent nitrogen (30.3 percent crude protein), 19.2 percent of

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which was uric acid. Oat straw and groundnut hulls had been used as the litter base to absorb moisture. Poultry litter has been used in fattening steers fed a concentrate consisting of high percent of chicken litter. This review, study of poultry manure as a simple and since it is the sure way to maintain quality and this can be particularly handy during the dry season when feeds are scarce.

Introduction:

The shortage of animal feeds is considered to be the major handicap affecting the development of the animal industry in most arid and semi-arid countries. Livestock in these countries depend primarily on natural pasture and range land. Some irrigated feeds such as alfalfa and oat grasses, are also used as feed for small ruminant animals. However, water shortages, drought, salinity, and problems of over grazing and range management have a direct affect on productivity. Fortunately, there are many non-conventional feeds and by-products which are available in these areas and considerably cheap. In the mid eighteenth century, a number of chemists had drawn attention to the presence of a particular nitrogenous substance "in urine". In 1973, F. M. Rouelle extracted from urine a substance on fermentation, carbonic acid and ammonia.

About 150 billion tons of animal waste is produced each year in the world. A large portion of this waste is from animals managed under intensive system, frequently close to municipalities, lakes, and streams. This waste must be handled properly to avoid the contamination of water supplies, and any risk to human health and comfort.

Approximately 50 billion tons of poultry waste is produced each year. Virtually all the waste is from intensive systems. In the past, animal waste has been used mainly as fertilizer. However, fertilizer is not an efficient use of poultry waste, especially in terms of cost of replacing lost nutrient. It has been proven that poultry waste is four times more valuable as a cattle feed ingredient than as a fertilizer. Wastes from different kinds of animals appear to have substantial nutritional value, especially from ruminant. Of all

animal waste, these from poultry appear to have the highest nutritional value. A feasible approach to utilization of poultry waste may be recycling by feeding.

Content and Utilization of Nutrients in Poultry Litter:

Broiler litter, the solid waste composed of bedding material, excreta, waste feed, and feathers is the usual type of waste resulting from broiler production. It may be from one or more crops of birds. The litter usually is high in nitrogen (crude protein) about 30% on dry matter basis (Table 1, 2 and 3). Litter may vary considerable in protein content, which precludes the use of standard values. However, much of the waste could be analyzed as is commonly done for forages. Protein nitrogen makes up about 40 to 50% of the total nitrogen in poultry waste.

The main non-protein nitrogen constituent in poultry waste is uric acid. Ruminants such as cattle and sheep can utilize uric acid and other non-protein nitrogen sources in the waste quite efficiently. In fact, in experiments in which up to 100% of the nitrogen was supplied by waste, the nitrogen was efficiently utilized. Since 50 to 60% of the nitrogen in the waste may be in the form of non-protein nitrogen, that protein would be essentially of no value to animals such as horses and poultry.

Broiler litter serves as an important source of energy, especially for ruminants. Average digestibility of energy by sheep, calculated by difference of broiler litter mixed with barley, and using straw and wood shavings as base materials, was 64%. The broiler litter contained 60% total digestible nutrient (TDN), 1108 kcal digestible energy, and 990 kcal of metabolizable energy per kg, dry basis, for ruminants (Noland, Ford and Ray 1955)

The total digestible nutrient in broiler litter is calculated from crude protein and crude fiber values. The energy value of broiler litter is about 24 to 30%... More than 40% of crude protein in the litter can be in the form of non-protein nitrogen. The non-protein nitrogen is mostly uric acid. The average crude fiber level of broiler litter is about 16 to 22%. This fiber content comes from chicken bedding material such as wood shavings, sawdust, and

grain straw. The chicken litter is an excellent source of minerals such as Ca, P, Na, K, Mg, Cu, Fe, and Zn. In fact, the macro and micro elements are present in the litter in large amounts.

Based on present feed prices broiler litter is worth about 40 dinar per ton in Libya on dry basis (Ahmed, 1995). However, in order for the waste to be valued at this level, it is essential that the ration be formulated so that none of the major nutrients such as energy, protein, calcium and phosphorus will be supplied in excessive amounts to minimize the cost.

Table (1). Nutrients content of broiler litter.

Component	%
Dry matter (%) Composition of dry matter	84.7 ± 4.2
Crude protein (%)	31.3 ± 2.9
True protein (%)	16.7 ± 2.4
Digestible protein (ruminant) (%)	23.3
Crude fiber (%)	16.8 ± 1.9
Ether extract (%)	3.3 ± 1.3
NFE (%)	29.5 ± 1.6
DE (ruminants) kcal/kg	2440
ME (ruminants) kcal/kg	2181
TDN (ruminants) (%)	59.8
Ash (%)	15.0 ± 3.2
Calcium (%)	2.4
Phosphorus (%)	1.8 ± 0.4
Magnesium (%)	0.44
Sodium (%)	0.54
Potassium (%)	1.78
Iron (ppm)	451
Cobalt (ppm)	.....
Copper (ppm)	98
Manganese (ppm)	225
Zinc (ppm)	235

Adapted from Fontenot *et al*., (1966).

From a complete nutritional standpoint poultry waste is a potentially valuable source of nutrients. Poultry litter contains substantial levels of calcium and phosphorus. In formulating rations, the waste could contribute significantly to the dietary calcium and phosphorus, and reduce the amount of supplemental sources needed. The waste also contains substantial amounts of most the trace minerals. A comparison of nutrient of broiler litter and other feed ingredients is given in Table (4).

Although the moisture content is not an important measure of nutrient value, it will determine the physical quality of the feed. If the moisture content is 25% or more, the feed mix will not flow easily through an auger. However, if the broiler litter is about 12% or less moisture, the feed might then be dusty, and therefore less palatable to the animals.

Table (2). Dry broiler litter composition.

Component	%	Component	%
Dry Matter (%)	84.7	Zinc (mg/kg)	11
Crude protein (%)	31.3	Vit B 12 (mg/kg)	827
True protein (%)	16.7	Lysine (%)	0.57
Digestible protein (%)	23.3	Histidine (%)	0.24
Crude fiber (%)	16.8	Arginine (%)	0.51
Ether Extract (%)	3.3	Aspartic acid(%)	1.22
NFE (%)	29.53	Threonine (%)	0.57
DE (sheep) kcal/kg	2440	Serine (%)	0.57
ME (sheep) kcal/kg	2181	Glutamic acid (%)	2.19
TDN (sheep) kcal/kg	72.5	Proline (%)	0.93
Ash (%)	15	Glysine (%)	2.14
Calcium (%)	2.37	Alanine (%)	0.88
Phosphorus (%)	1.8	Cyctine (%)	0.09
Sodium (%)	0.54	Valine (%)	0.82
Potassium (%)	1.74	Methionine (%)	0.13
Magnesium (%)	0.44	Isoleucine (%)	0.64
Manganese (mg/kg)	225	Leucine (%)	1.0
Iron (mg/kg)	451	Tyrosine (%)	0.33
Cobalt (mg/kg)	98	Phenyl alanine (%)	0.54

Table (3). Dry layers litter composition.

Component	%	Component	%
Dry matter (%)	89.65 ± 7.7	Cl (%)	0.94
Crude protein (%)	28 ± 3.2	Selenium (%)	3.85
True protein (%)	11.3 ± 1.4	Copper (mg/kg)	1.36
Digestible protein (sheep) (%)	14.4	Alanine (%)	1.14
Crude fiber (%)	12.7 ± 1.7	Arginine (%)	0.50
Ether extract (%)	2 ± 0.5	Aspartic acid (%)	1.14
NF+E (%)	28.7 ± 2.8	Cystine (%)	1.17
Gross energy kcal/kg	3533 ± 234	Glutamic acid (%)	1.66
DE (cattle) kcal/kg	1875	Glysine (%)	0.88
DE (sheep) kcal/kg	1911 ± 171	Histidine (%)	0.22
TDN (sheep) (%)	52.3	Isoleucine (%)	0.53
Ash (%)	28 ± 1.5	Leucine (%)	0.86
Calcium (%)	8.8 ± 1.1	Lycine (%)	0.51
Phosphorus (%)	2.5 ± 0.6	Methionine (%)	0.10
Magnesium (%)	0.67	Phenyl alanine (%)	0.48
Sodium (%)	0.94	Proline (%)	0.56
Potassium (%)	2.33	Serine (%)	0.55
Iron (%)	1.36	Threonine (%)	0.51
Cobalt (mg/kg)	150	Tyrosine (%)	0.28
Zinc (mg/kg)	463	Valine (%)	.65

Long-term impact of broiler litter as a fertilizer:

The broiler litter produced in poultry houses varies from house to house. However, it is well known that each poultry house generates about tons of poultry litter each year. Broiler litter contains the equivalent of approximately 26 – 22 – 16 Kg per ton of N, P_2O_5 and K_2O on dry matter basis. This nutrient analysis is

the equivalent of a bag of commercial fertilizer at 3%, 2%, 5% and 2% of N, P_2O_5 and K_2O, respectively (Kingery *et al*., 1994).

Forage crop growth response to broiler litter is slow, because the nitrogen is organically bound. This results in the nitrogen not being as readily available as that in the commercial fertilizers. Also the improper application of broiler litter can create potential nutrient buildup problems in certain soils. Other concerns include runoff of litter material into streams though the soil profile and into ground water supplies. Also the buildup of certain minerals in the soil as a result of long term broiler litter application of broiler litter over several years led to soil test results that are low in potassium (K), and adequate to high in P, Ca and Mg (Hilleman. 1967).

Table (4). Composition of cattle feeds compared with broiler litter.

Feeds and litter	Percent composition of dry matter					
	DM %	CP %	CF %	TDN	Ca	P
Alfalfa (Early Bloom)	90	18.4	29.8	57	1.25	0.03
Broiler litter	89	31.3	14.9	60	2.82	2.37
Corn silage	40	8.1	24.4	70	0.27	0.02
Corn and cob meal	87	9.3	9.2	90	0.05	0.31

Adapted from Bhattacharya and Fontenot. (1965).

Animal nutritionists were among the first to report concerning the feeding of poultry waste. They found that the performance of gestating-lactating ewes fed a ration containing ground poultry litter was similar to that of ewes fed a ration containing soy bean meal. When energy intakes were equalized, rate of gain of fattening steers fed poultry litter was similar to that steers fed cottonseed meal. In an experiment in the USA (Virginia) the rate of gain steers fed a fattening mixture containing 25% peanut hull or wood showing broiler litter, plus 1.2 kg long hay per

day, was similar to that of steers fed a control mixture and long hay. It has also been found that feeding litter with base materials, peanut hulls, corn, cobs, grass hay and soybean hulls, produced results similar to the performance of cattle fed fattening mixture plus a limited amount of long hay. Performance was usually higher for cattle fed mixture with 25% litter, compared to 40%. Broiler litter has also been used successfully to feed beef cows and growing heifers (Caswell *et al*., 1977).

Handling and processing of poultry litter:

In the processing of litter; it is important to destroy potential pathogens and ensure storage quality. The litter should be free of mold. In order to guard against the presence of wire, nails, or other metal in the litter it should be run over a magnet. Or perhaps in a hammer mill to remove these objects which may cause hardware disease in ruminants. Rocks, glass and other foreign material should also be removed

Heat drying of the broiler litter has been shown to result in as much as a 20% reduction in nitrogen. This loss can be reduced by acidification of the waste prior to drying. Treating broiler litter by autoclaving, followed by air drying, with different levels of paraformaldehyde prior to heat drying and by fumigation with ethylene oxide does not substantially affect the chemical composition, efficiency, or utilization of nitrogen by ruminants.

Rations containing broiler litter:

Although broiler litter can be used efficiently as a fertilizer, it has greater potential economic impact as a feed source for ruminant animals. Based on nutrient analysis, good quality broiler litter is equal to good alfalfa/alfalfa hay. Broiler litter is not as palatable as other common feed sources, and ruminant animals require a period of time (2 – 3 weeks) to adjust to the taste. To make a broiler litter diet more palatable and increase its consumption, barley, corn, or any other grain should be added.

Beef cattle:

Beef cow rations offer great potential for the use of broiler litter. Cattle may be wintered on a mixture of 80% broiler litter and 20% ground corn/barley, or other palatable concentrates. Litter alone would not be palatable nor would it meet the energy and protein needs of pregnant beef cows even if they ate enough of it. A small amount of hay or other forage should also be fed for normal digestion and health.

Pregnant cows should be fed 4 – 6 kg of the litter mixture per head per day along with 2 – 3 kg of hay or equivalent forage. For cows nursing calves, the amount of the litter mixture be should increase to 7 – 9 kg per head daily, while continuing to feed a small amount of hay or other roughage (Noland *et al*., 1955).

Calves may successfully feed on ration of 50% broiler litter and 50% ground corn/barley along with hay fed free choice for 200 – 250 kg. Calves being fed to gain 1.0 to 1.5 kg per day, 4 kg of the mixture should be fed each day. The amount of the mixture will need to be adjusted depending on the amount of hay fed (Caswell *et al*., 1978).

Broiler litter can supply up to 20 – 25% of the dry matter in beef cattle finishing ration. It can be fed either as litter ensiled with corn/barley silage, by mixing deep stacked or ensiled litter with corn/barley silage, or along with other ration ingredients at feeding time. When fed with corn/barley silage plus concentrates such as ground corn/barley at 1% of body weight, 20% broiler litter in the ration on an **"**as fed**"** basis will provide all the protein needed to balance the ration. For example, fattening yearling steers weighing 300 – 400 kg, and gaining at the rate of 1.5 kg per day require about 1.5kg of crude protein and 60% of TDN daily. A daily ration of 10 – 12 kg of corn/barley silage, 25 kg of broiler litter, and 3 kg of corn/barley will supply the energy and protein required (Noland et al., 1955).

Sheep:

Results have demonstrated that sheep can utilize the energy, protein and other nutrients in broiler litter very efficiently. Fattening lambs can be fed a ration of 25% ground hay, 25% broiler litter and 50% ground corn/barley include 4 – 5 kg of ground limestone per ton (Bhattacharya and Fontenot. 1965).

Self-feeding a mixture of 50% ground hay, 25% corn/barley and 25% broiler litter to ewes would provide sufficient protein, energy, calcium and phosphorus. Limestone should be added above. a mixture of 50% litter and 50% ground corn/ barley may be fed to pregnant and nursing ewes .about 1kg per head daily should be fed before lambing and 1.5 to 4kg per head after lambing . Ewes fed this ration will need hay or other roughage / all of the sheep relation need to be supplemented with vitamin A and salt (not trace mineralized).

The limitation of feeding broiler litter t0 sheep comes from the sensitivity of sheep to high, because of the use of copper compound in broiler production. When feeding broiler little relation to sheep, it should be done with regard to the following precaution;

1. Feeding of broiler litter to sheep should be limited to maximum of 60 days.
2. The amount of broiler litter in sheep rations should be low.
3. Broiler litter rations should be given to sheep only when no other source of nitrogen is available.

Health aspects of feeding poultry litter:

For more than 50 years poultry litter has been used as a part of ruminant feeds. This has not resulted in an undesirable flavor in meat (Roger Crickenberger and Lemud Grood 1966).

There has been no indication of any harmful effects to human consumption of ruminant meat, milk and eggs from animals fed poultry wastes. Also no disease problems have been reported

from including poultry waste in practical rations for dairy and beef cattle.

When feeding poultry waste to sheep for long periods; it has been noticed that there occasionally occurs some copper toxicity. But this happens only when sheep are feed poultry waste for long periods at levels of more than 30% of the ration (Alexander *et al*., 1968).

Summary and conclusions:

It appears that poultry litter has substantial value for ruminants. It is high in crude protein and the nitrogen is efficiently utilized. The energy of poultry waste also appears to be utilized efficiently by ruminants. The waste can be rendered free of pathogenic organisms by heat treatment, or a combination of both chemical and heat treatment.

A satisfactory performance has been obtained from the feeding of poultry litter. The level of waste fed would depend on the level of production desired and the type of animal. In the case of feeding beef cows a level as high as 80% of broiler litter may be used. However in the case of fattening cattle, probably the upper limit would be around 25%.

The only documented harmful effect on animal heath from the feeding of poultry waste has been copper toxicity in sheep. It does not appear that this will be a problem in cattle, which are not as sensitive to high copper levels. With proper precautions, broiler litter can be a primary ingredient in an economically successful operation. Using broiler litter as a fertilizer and a feed in the ruminant animal is probably the most environmentally sound and economically efficient for use an agricultural enterprise

القيمة العلفية لزرق الدواجن للمجترات

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المستخلص:

من خلال الدراسات والبحوت التي تم إجراؤها على رزق الدواجن في عدة مناطق من العالم تبين ان زرق الدواجن يحتوي على عناصر غذائية هامة للمجترات، حيث يعتبر زرق الدواجن عالي النيتروجين الغير بروتيني الذي تستفيد منه المجترات بشكل كبير جدا نظرا لوجود الإحياء المجهريه في كرشها.

ومن الممكن القضاء على الجراثيم الضارة للحيوان و الموجودة في الزرق عن طريق المعاملة الكيميائية او الحرارية للزرق او باستخدام الطريقتين معا.

وقد أوضحت الدراسات والبحوث ان إدخال زرق الدواجن في علائق الأبقار بنسبة 10% من العليقة وحوالي 33% من بروتين العليقه يزيد من أوزان الأبقار وإنتاجيتها.

بالنسبة للأغنام فإنه ينصح الاتزيد النسبة عن 5% من زرق الدواجن في العلائق المقدمة لها، وقد تحدث بعض الأضرار الصحية للأغنام نتيجة لربط او اتحاد العناصر المعدنية مع هدا الزرق وبالتالي عدم استفادة الحيوانات من هده العناصر.

إن الضرر الوحيد من تغذية زرق الدواجن للمجترات هو أنه من الممكن ان يحدث تسمم من النحاس للأغنام نتيجة وجود كميات كبيرة من النحاس فى زرق الدواجن. ان زرق الدواجن مهم كغذاء للمجترات بجانب استخدامه كسماد لتسميد الحقول الزراعية. تكلفة إدخاله كجزء من عليقة المجترات منخفضة مقارنة بمصادر غذائية أخرى. ينصح بأسخدامه في علائق أبقار اللحم واللبن وكذلك وفى أعلاف الماعز. من كل النتائج المتحصل عليها في جميع التجارب التي وردت بهده الورقة أثبتت أن استخدام اليوريا في علائق المتجرات مفيد جدا.

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