Full Length Article

COMPOSITION OF 'NEW GENERATION' DRIED DISTILLERS' GRAINS WITH SOLUBLES AND ITS DIETARY EFFECT ON THE PERFORMANCE OF COMMERCIAL VANARAJA CHICKENS

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ABSTRACT

'New generation' Dried Distillers' Grains with Solubles (DDGS) collected from modern ethanol plants were analysed for its nutritional composition and included in the diet to assess the performance of commercial Vanaraja chickens. Six numbers of commercial 'new generation' DDGS samples collected from modern ethanol plants were analyzed for their basic nutrient composition and amino acid profile. Five isocaloric and isonitrogenous experimental diets containing graded levels of 'new generation' DDGS (0, 2.5, 5.0, 7.5 and 10% DDGS) were formulated as per ICAR-DPR standards for Vanaraja chickens basis, and fed for chicks (9 replicate pens containing 6 chicks each) of commercial dual purpose birds of Vanaraja strain for the period of 6 weeks. Growth performance of birds was recorded at 7, 14, 21, 35 and 42 days of age and 9 representative birds per treatment (one each from replicate pen) were randomly selected and processed to study their carcass yield and characteristics. The ME and CP content of 'new generation' DDGS is 2850±57 Kcal/Kg and 27.35±1.16%, respectively. There was no significant ($P>0.05$) difference in the growth performance of birds during chick stage (7 to 21 days) and during early finishing stage (35 days) birds fed diets containing ≥5.0% 'new generation' DDGS had shown lower weight gain and significantly ($P<0.05$) poor feed conversion compared to Control. There was no significant difference in the carcass yield and its characteristics between the dietary treatments. Good quality protein rich 'new generation' DDGS can be used (10%) in the diets fed to commercial Vanaraja chickens without significant impact on overall performance of birds.

Key words: Bird performance, New generation DDGS, Vanaraja chickens, Nutrient composition

INTRODUCTION

Historically, dried distillers' grains with solubles (DDGS) has been a by-product of beverage industry, for the most part, with several different grains used in

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the fermentation process. In the late 1930s, feed producers began to incorporate DDGS into livestock and poultry rations, but before this, it was a by-product with limited value (Scott, 1970). In addition to beverage industry, ethanol plants are also producing DDGS as by-product of the industry. The DDGS from ethanol plants is largely from corn fermentation and undergoes a supposedly gentler drying process than DDGS produced by the beverage industry, both of which may allow 'new generation' DDGS to be a more valuable ingredient than before (Zwitkiewicz and Koreleski, 2008). Expansion of the ethanol industry in the late 1990's brought about increased supply of 'new generation' DDGS sparking interest by feed companies and nutritionists to examine the use of this byproduct in poultry feeds.

Concerns regarding the utilization of DDGS still remain quite often that of variability in its physical characteristics, nutrient composition and level of inclusion in poultry feeds. The nutrient composition of DDGS varies depending on the source of grain and the methods used for DDGS production. Fermentation residues from the beverage industry may be based on mixtures of several grains, whereas the 'new generation' DDGS is usually from ethanol plants with corn as the only grain input. This 'new generation' DDGS is protein rich feed resource, on average it contains approximately 30% CP on DM basis (Bottger and Sudekum, 2018). Earlier livestock research studies have indicated that 'new generation' DDGS has higher levels of apparent ileal digestible amino acids (Whitney *et al*., 2000), available Phosphorus (Whitney *et al*., 2001) and ME content (Waldroup *et al.,* 2007) than values published earlier by NRC (1998).

There are some questions as to acceptable levels of 'new generation' DDGS in poultry diets. DDGS has been used in commercial chicken diets at a level of 5% or less for many years. Day *et al.,* (1972) observed an increase in weight gain when broiler birds were fed diet containing low levels of DDGS (2.5 and 5%). Lumpkins *et al*. (2004) indicated that DDGS from modern ethanol plants can be safely used at 6% in broiler starter diets and 12 to 15% in grower and finisher diets. Noll (2005) recommended a maximum inclusion level of 10% of 'new generation' DDGS in the diet fed to broiler birds. Similarly, it has been suggested that up to 15% DDGS could be used in layers diets without adverse effects on performance of the birds (Roberson *et al*., 2005; Swiatkiewicz and Korleski, 2006).

As very little research has been published pertaining to utilization of 'new generation' DDGS from modern ethanol plants in poultry diets, and limited nutritional information is available, the study was taken to evaluate the nutritional composition and utilization of 'new generation' DDGS in the diets fed to commercial dual purpose birds of Vanaraja strain.

MATERIALS AND METHODS

Samples of commercially prepared 'new generation' DDGS collected from six modern ethanol plants located at Krishna and Nandyal of Kurnool District, Telangana were analyzed for their basic nutrient composition and complete amino acid profile as per AOAC (1995). Its ME content was determined by metabolic trial conducted with adult cockerels as per the standard procedure. Five experimental diets (Table 1) containing 0, 2.5, 5.0, 7.5 and 10% of ‘new generation’ DDGS were formulated to be isonitrogenous and isocaloric with constant Lysine and Methionine levels for each treatment as per ICAR-DPR standards for birds of Vanaraja strain. All diets were fortified with complete vitamin and trace mineral mixes.

Table 1. Composition of experimental diets containing graded levels of ‘new generation’ DDGS

Component	Control	‘new generation’ DDGS			
		2.5 %	5.0 %	7.5 %	10 %
Ingredients (%)					
Maize	47.84	46.59	45.32	44.06	42.79
Soybean meal	23.52	22.02	20.47	18.91	17.36
De-oiled Rice Bran	25.61	25.89	26.18	26.48	26.79
‘new generation’ DDGS	0.00	2.50	5.00	7.50	10.00
Di-Calcium Phosphate	1.15	1.11	1.07	1.03	0.98
Shell Grit	0.81	0.85	0.89	0.94	0.98
Common Salt	0.42	0.42	0.42	0.42	0.42
DL-methionine	0.12	0.11	0.11	0.11	0.10
L-Lysine HCl	0.02	0.003	0.03	0.05	0.07
Vit AB_2D_3K	0.015	0.015	0.015	0.015	0.015
Vit B-Complex	0.015	0.015	0.015	0.015	0.015
Choline Cl (50%)	0.06	0.06	0.06	0.06	0.06
Trace Minerals Mix	0.12	0.12	0.12	0.12	0.12
Toxin Binder	0.20	0.20	0.20	0.20	0.20
Coccidiostat	0.05	0.05	0.05	0.05	0.05
Antibiotic	0.05	0.05	0.05	0.05	0.05
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Nutrients					
ME (Kcal/Kg)	2600	2600	2600	2600	2600
Crude Protein (%)	18.00	18.00	18.00	18.00	18.00
Crude fibre (%)	5.99	5.90	5.81	5.72	5.64
Calcium (%)	0.70	0.70	0.70	0.70	0.70
Available P (%)	0.35	0.35	0.35	0.35	0.35
Lysine (%)	0.90	0.88	0.88	0.88	0.88
Methionine (%)	0.40	0.40	0.40	0.40	0.40
Meth + Cyst. (%)	0.72	0.72	0.73	0.73	0.73
Linoleic Acid (%)	1.05	1.02	0.99	0.96	0.93

Each of the dietary treatments was fed to 9 replicate pens of 6 chicks each. Commercial dual purpose chicks of Vanaraja strain were obtained from a local hatchery where they had been vaccinated *in ovo* for Marek's disease and had received vaccinations for Newcastle Disease and Infectious Bronchitis post hatch via a coarse spray. There were 5 rows of 54 birds each at the beginning of the study. Each row contained 9 cages of 6 birds each and cage size was 16" x 20" to provide 80 square inches per bird. This cage density level was necessary to meet bird care standards which require that all birds have at least 72 square inches of cage space. Feed was provided by hand feeding each day and water was provided to birds in a linear waterer which was kept at opposite side to feeder. Manure was scraped from beneath the cages each day and removed from the house. Temperature and airflow were controlled by automatic heaters and ventilation fans. Incandescent lights supplemented natural daylight to provide 23 h light daily. Mortality was checked daily.

Weight gain, feed intake and feed conversion ratio (Feed/gain) were determined for each pen at 7, 14, 21, 35 and 42 days of age. To investigate a possible effect of 'new generation' DDGS on carcass yield and characteristics, 9 birds per treatment (one each from replicate pen) were randomly selected for processing at 42 days of age and starved for 10 hrs before processing. After processing, yield of carcass, abdominal fat, breast meat and liver were determined.

Data from the experiment were subjected to ANOVA procedure for completely randomized design (Steel and Torrie, 1980). Statistical significance of differences among treatment means was assessed using the Duncan's test. A probability level of $P<0.05$ was used to determine statistical significance.

Table 2. Nutrient composition (Mean ± S.E) including amino acid profile of 'new generation' DDGS

Nutrient	Composition (88 % DM)
ME (Kcal/Kg)	2850±57
CP (%)	27.35±1.16
Ca (%)	0.08±0.003
P (%)	0.42±0.007
Amino Acid Profile (%)	
Methionine	0.60 ±0.007
Cystine	0.53±0.001
Lysine	0.68±0.0007
Threonine	1.00±0.007
Arginine	1.10±0.003
Isoleucine	1.01±0.003
Leucine	3.60±0.013
Valine	1.32±0.002
Histidine	0.74±0.008
Phenylalanine	1.40±0.003
Glycine	0.93±0.002
Serine	1.31±0.023
Proline	2.40±0.011
Alanine	2.08±0.0073
Aspartic acid	1.67±0.012
Glutamic acid	5.07±0.010
TSAA	1.13±0.09

RESULTS AND DISCUSSION

Nutrient Composition

The nutrient composition including amino acid profile of 'new generation' DDGS is shown in Table 2. After high quality kernels of corn are ground, starch molecules are converted into sugar and fermented into ethanol. The resulting by-product is rich in essential nutrients. Analysis of 'new generation' DDGS samples used in this study indicated that nutrient composition of 'new generation' DDGS was in fairly good agreement with the values used in formulation of the diets. The ME content of 'new generation' DDGS used in the study is within the reported review values of 2480 - 2880 Kcal/Kg for corn DDGS from ethanol plants (Salim *et al.,* 2010). Similarly, CP content of test ingredient is also within the reported value by Dale and Batal (2005) who reported CP content of corn DDGS can vary from 24 - 29 %. Salim *et al.* (2010) assessed the CP content of 395 samples of 'new generation' DDGS imported to Korea from the US and the average CP content was 27.15 % (23.87-30.41) with 3.72 % coefficient of variation. However, several factors affect the nutritional and physical characteristics of DDGS causing variability in its composition. These includes the variability of nutrient levels in the corn sources, proportion of distiller's soluble added to DDG before drying (Martinez-Amezcua *et al.,* 2007), efficiency of converting starch to ethanol and temperature and duration of drying (Carpenter, 1970; Olentine, 1986). Rasco *et al.* (1989) found that CP content of DDGS was most affected by drying method of grain sources. The effect of drying method on CP content was attributed to the loss of fine particles during drying. Amino acid profile of 'new generation' DDGS revealed, many of the key essential amino acids including Methionine, Alanine and Phenylalanine were equal or superior to reported values. Dong *et al.* (1987) reported that the amino acid profile of distillers' grains is similar to that of the parent grains. As a result, differences in amino acid composition of distillers' grains reflect differences in amino acid composition of the parent grains.

Growth performance

During early chick stage (1 to 21 days), live body weight and feed conversion (Feed/gain) of birds were not significantly ($P>0.05$) affected by levels of 'new generation' DDGS in the diets (Table 3). However, during late finishing period (35 to 42 days), birds fed DDGS diets had shown lower BW as compared to control; but there was no significant differences. This resulted in feed conversion (Feed/gain) get significantly ($P<0.05$) increased for birds fed diets containing ≥5.0 % DDGS at 35 days of age. Similarly, broiler birds fed diets containing high level of DDGS had shown poor growth performance which was explained by lack of formulating diets to supply all digestible amino acids to the birds (Wang *et al.,* 2007). It has been noted that digestibility of several amino acids in DDGS is relatively poor, especially Lysine and Threonine (Batal and Dale, 2006; Fastinger *et al.,* 2006; Waldroup *et al.,* 2007). Failure to compensate the reduced amino acid digestibility of formulated diets may inhibit the dietary usage of high levels of DDGS for young growing birds. Moreover, the temperature at which these 'new generation' DDGS is dried also affect its amino acid bioavailability to the birds (Martinez-Amezcua *et al.,* 2007).

Table 3. Growth performance of commercial Vanaraja chickens fed diets containing graded levels of 'new generation' DDGS

DDGS (%)	7 days		14 days		21 days		35 days		42 days	
	BW (g)	Feed/ Gain	BW (g)	Feed/ Gain	BW (g)	Feed/ Gain	BW (g)	Feed/ Gain	BW (g)	Feed/ Gain
0	89.03 ±0.11	0.88 ±0.009	151.76 ±2.27	1.31 ±0.014	252.27 ±3.05	1.61 ±0.017	545.03 ±8.96	2.00 ±0.085[c]	715.32 ±8.42	2.14 ±0.074
2.5	87.62 ±0.88	0.89 ±0.003	141.36 ±2.93	1.38 ±0.021	249.74 ±3.63	1.65 ±0.016	501.39 ±8.27	2.27 ±0.081[bc]	691.81 ±9.09	2.30 ±0.068
5.0	86.77 ±0.92	0.89 ±0.008	141.91 ±2.81	1.35 ±0.013	257.23 ±3.11	1.65 ±0.017	466.02 ±7.45	2.61 ± 0.091[a]	666.88 ±8.63	2.49 ±0.071
7.5	84.83 ±0.83	0.91 ±0.006	143.03 ±2.09	1.32 ±0.017	250.75 ±3.71	1.61 ±0.013	499.02 ±9.43	2.29 ± 0.033[b]	700.28 ±8.86	2.27 ±0.069
10	84.96 ±0.86	0.90 ±0.008	142.76 ±2.64	1.29 ±0.013	258.31 ±3.21	1.63 ±0.016	478.43 ±8.54	2.49 ± 0.093[ab]	693.76 ±9.11	2.38 ±0.081

[a b c] Mean ±SE bearing different superscripts within a column differ significantly (P<0.05)

Carcass characteristics

Feeding graded levels of 'new generation' DDGS to Vanaraja chickens had no adverse effect on carcass yield when observing ready to cook yield and selected carcass parts; abdominal fat, breast meat and liver (Table 4). Similarly, Lumpkins *et al*. (2004) fed diets containing 0, 6, 12 and 18 % DDGS for 42 days and observed no differences in carcass yield when observing the selected carcass parts of broilers. Although differences in carcass yield were not significant in the present study, weight of abdominal fat and breast meat as percentage of total carcass weight were numerically heavier when the birds were given diets containing 10 % 'new generation' DDGS. Similar trends in weight of breast meat (Min *et al.,* 2009; Wang *et al.,* 2008) and abdominal fat (Tadtiyanant *et al.,* 1993) were observed in broiler birds fed diets containing high levels of DDGS.

Table 4. Carcass and its parts yield (g/kg) of commercial Vanaraja chickens fed diets containing graded levels of 'new generation' DDGS

DDGS (%)	Ready to Cook yield	Abdominal Fat	Breast Meat	Liver
0	65.52±5.73	3.15±0.05	14.05±8.42	1.95±0.04
2.5	66.15±5.02	3.22±0.06	15.25±7.76	1.99±0.04
5.0	65.25±6.17	3.11±0.05	15.02±8.42	1.98±0.03
7.5	66.09±5.11	3.21±0.06	14.59±6.78	1.85±0.04
10	65.68±5.88	3.30±0.06	14.98±7.74	1.99±0.03

In conclusion, up to 10 % 'new generation' DDGS of known composition and good quality can be added in the diets fed to commercial chickens of Vanaraja strain without negative impact on overall growth performance and carcass yield of birds.

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