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Popular Article

Use of Dried Distiller Grain Solubles as A Feed Ingredient in The Diets of Livestock

Ankur Mishra[1], Akash wadal[1], D. Tewari[2], V.K Singh[3], Nidhi Verma[4], Sonu Jaiswal[5]
[1]PG Scholar, Department of Animal Nutrition [2]Assistant Professor, Department of Animal Nutrition [3]Professor and Head, Department of Animal Nutrition
[4]Ph.D. Scholar, Department of Animal Nutrition
[5] Professor and Head, Teaching Veterinary Clinical Complex, College of veterinary science and Animal Husbandry, ANDUAT Kumargan, Ayodhya
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Introduction

Identifying alternative fuels produced from plant biomass is essential due to the potential depletion of non-renewable energy sources plus the negative impact that burning them causes to the environment. **Distillers' dried grain with soluble (DDGS)** is a residual product obtained from the process of bioethanol fermentation. This process involves the use of dry milling technology on grains that are high in starch, such as corn, wheat, and barley. The present surge in bioethanol is driven by the demand for sustainable liquid fuels, particularly in the transportation industry. Due to its high content of crude protein, fat, fiber, vitamins, and minerals, DDGS is presently employed as feed for aquaculture, livestock, and poultry. DDGS has been utilized as a feedstock in the manufacturing of value-added goods through microbial fermentation in recent years. Several investigations have documented the generation of organic acids, methane, biohydrogen, and hydrolytic enzymes by the utilization of DDGS. Pretreatment of DDGS is necessary to extract the fermentable sugars, despite the significant presence of macronutrients in DDGS. The pre-treatment procedures, which might be of chemical, physical, or biological origin, are employed either individually or in combination to achieve optimal yields for various applications.

Bioethanol Production Process and Types of Distillation Decoctions

The molecular formula of ethyl ethanol is C2H5OH and its calorific value is 19.6 MJ/L.

There are two technological methods for extracting ethanol from corn: the wet and dry processes. The processes exhibit similarities, however provide distinct outputs. Dry grinding enables a higher production capacity of bioethanol, with the sole additional byproduct being animal feed in the form of WDGS and DDGS. While employing wet technology, in combination to ethanol and animal feed, corn oil, corn syrup, and gluten are obtained. The production of ethanol necessitates a two- step process of starch fermentation. The initial step involves the breakdown of starch into glucose and maltose, while the subsequent step entails yeast fermentation, whereby disaccharides and monosaccharides are transformed into ethanol. Enzymes and temperature degrade the polymeric structure of starch. The industrialized process employs two enzymes. The initial enzyme is α- amylase, which functions to catalyze the hydrolysis of polymers into shorter chains (dextrins) that endure in the solution. This process is referred to as the condensation step. During the saccharification step, the presence of glucoamylase causes the conversion of dextrins into two types of simple sugars: glucose and maltose, which is a dimer of α-1–4glucose. Yeast (Saccharomyces cerevisiae) ferments the resulting solution, converting glucose into carbon dioxide and alcohol. After the fermentation process is complete, the liquid is distilled, and the solid and liquid components of the decoction are separated using decanters. The decanters' solid contents are combined with the liquid's syrup after it has been evaporated and condensed. The resulting brew is centrifuged, dried, and then ground into granules.

Dried distillers' decoction can take several forms depending on the technology employed in its production: wet distillers' grain **(WDG)**, wet distillers' grain with solubles **(WDGS)**, and high-protein wet distillers' grains **(HPWDG)**, as well as dried distillers' grain **(DDG)**, dried grain with solubles **(DDGS)**, and high-protein dried distiller's grains **(HPDDG).**

Composition And Type of DDGS

Depending on the grains used in manufacture, there are several different varieties of DDGS. The composition of DDGS can also be influenced by the grains, the ethanol production technique, the production site, and the batch of grain.

Corn DDGS

Corn DDGS is the most common in India due to its high corn production. Another factor for corn's choice is its high fermentable starch content **(Shurson and Noll 2005).** Due to its widespread availability in animal feed, corn DDGS has been studied more than other feedstock grains. DDGS composition varies per corn type. The high protein and fat content

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of DDGS is the major reason it is fed to animals. Dry corn DDGS has 26%–33.3% crude protein. Different reports indicate 9.1% to 14.1% factor oil **(Liu 2011**). NDF can be 33–40% and ADF 11–20%. **Chrenková et al; (2012)** found that maize DDGS has more fat and less crude protein than other feedstock grains. Ash and total organic matter in the batch are also important.

DDGS Wheat

According to **Chrenková et al. (2012),** there are differences in the nutritional profiles of wheat DDGS and corn DDGS, particularly in terms of their variability. The wheat DDGS can exhibit a crude protein concentration ranging from 13.4% to 40.1% as seen in Table 1. The significant variability of wheat DDGS determines the level of uncertainty regarding its quality as animal feed. The fat content exhibits significant variability, ranging from 1.5% to 5.4%. Nevertheless, this quantity is considerably less than the fat content seen in maize DDGS.The NDF content in wheat DDGS is like that found in maize DDGS.

Barley DDGS

Barley DDGS is a by-product of the brewery sector and constitutes a smaller proportion compared to other types of DDGS. According to **Mustafa et al. (2000)**, the crude protein content in barley DDGS ranged from 14.9% to 15.9%. The fat percentage in barley DDGS is similarly reduced, ranging from 5.7% to 6.3%. Conversely, the barley DDGS has a higher fiber content compared to wheat or maize DDGS **(Wu 1986)**. Barley DDGS contains a fiber content above 166 grams per kilogram. The study conducted by **Mustafa et al. (2000)** indicated that NDF, which constitutes a significant portion of crude fiber, accounted for 78.9-79.5%.

Combined Types of DDGS

One further approach to reduce the expense of ethanol manufacturing and enhance the viability of the production procedure is to employ a blend of various types of grains as feedstock. Multiple research projects provide information on the nutritional makeup of mixed DDGS. **Weiss et al. (1989)** state that DDGS is composed of 65% barley and 35% corn. The mixture analyzed in this study contains 38% neutral detergent fiber (NDF) and 27% crude protein content, as reported by **Weiss et al. in 1989**. A separate investigation documents many constituents including wheat, maize, barley, triticale, and sugar beet syrup **(Böttger and Südekum 2017).** The impact of these various combinations on the levels of crude protein and fiber content determines the effectiveness of the mixture in many applications, including its usage as animal feed.

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Use Of DDGS in Cattle

Calves need a lot of protein as they grow, and DDGS is a great way to meet that demand while also providing calories for their creep diets. Producers can improve cattle performance and lengthen the grazing season by feeding distillers dried grains with solubles (DDGS) to cattle on high forage diets. Depending on the situation and the animal's requirements, DDGS may be fed at a rate of 0.25 to 1.0% of body weight. DDGS, as a rich source of protein, can replace part of the total mix ration (TMR) to feed dairy cattle, while it can also be a source of energy to replace some of the grains .in dairy cow feed **(Zhang et al., 2010)**. Feed efficiency improved somewhat when DDGS was used to replace some of the TMR **(Kelzer et al., 2009).** Milk yield, protein, and lactose content were all improved when DDGS was used to replace 20% of the barley grain or silage in the diet. There is no need to worry about acidosis in the rumen because rumen pH was not affected **(Zhang et al., 2010).**

Use of DDGS In Sheep and Goat

When used as a source of nutrition for sheep, DDGS has no effect on either animal health or milk production. However, DDGS can stand in for all or most of the soybean meal and up to 31% of the corn in goat diets. Feed intake, weight gain, and carcass quality can all be maintained when DDGS are included in a goat's diet **(Maynard, 2015)**. Other writers have not shown that feeding DDGS reduces productivity in slaughter animals, alters the composition of the carcass, or changes the fatty acid profile of sheep meat. The scientists have also shown that DDGS is an excellent nutritional choice for sheep, increasing the weight of newborn lambs and having no effect on their mortality. Sheep TMR using DDGS is not as common as TMR with other livestock species **(Sahin et al., 2013)**. Since DDGS contains a very high concentration of protein—the most expensive component for animal feeding—its use in sheep feeding is very cost-effective. **(Pezzanite et al., 2010)**

Use of DDGS In Swine

DDGS can be included in pig diets during the entire life cycle. There is no evidence that feeding pregnant sows or growing piglets a diet that includes 30 percent distillers dried grains with solubles(DDGS) is harmful to either the sows or the piglets **(Stein &Shurson, 2009).** Pigs' growth and food consumption were aided because of this. The nursery diet must be really appealing. Reduced feed intake is seen when distillers grains make about 25% of the diet. Therefore, most nutritionists advise limiting distillers grains in the diets of growing and finishing pigs to no more than 20%. It seems that for lactating sows, a level of inclusion of around 20% is optimal. It appears that feeding lactating sows a diet that includes distillers

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also boosts feed consumption. If sows have been exposed to distillers before lactation begins, the sows will consume more feed throughout lactation. There may be health benefits to feeding pigs distillers. Piglets frequently suffer from proliferative ileitis, an inflammation of the piglet's ileum. The incidence and severity of this condition can be mitigated by adding 10 percent distiller's grains.

Use of DDGS in Poultry

The simplest approach to combat the rising prices of soybean meal and yellow corn is to incorporate DDGS into chicken diets **(El-Hacket al., 2019)**. DDGS is a rich source of xanthophylls, particularly Lutein and Zeaxanthin **(Sommer burg et al., 1998**). Maximum 25% incorporation of DDGS in broiler feed mix ration was advised by Waldroup et al. (1981). By boosting the yellow and red pigmentation of skin and egg, DDGS in chicken feed increases consumer demand for food products like eggs and broilers. Starter (0-16 days), grower (17-31 days), and finisher (32-42 days) DDGS levels in the poultry feed should not exceed 6%. Chickens fed a diet with a higher percentage of DDGS gained weight more efficiently **(Lumpkins et al., 2004).** For optimal egg weight and yolk color, **El-Hacket al. (2019)** suggested no more than a 12% DDGS inclusion in the hens' diet.

Conclusion

The growing inclination towards producing biofuel from maize ethanol results in a higher volume of byproducts derived from corn. The main byproduct generated in the production of bioethanol is known as DDGS (Dried Distillers Grains with Solubles). Plants, primarily by the process of dry- grinding procedure, which has been used as a commodity of minimal worth Feed for animals. The producers must Enhance the market appeal and functional applications of DDGS to Ensure the ethanol plant operation has a sustainable and prosperous economy**.** Although the nutritional value varies because of the raw material, DDGS's high nutritional value makes it a good source of nourishment for both humans and animals' components, procedures, etc**.** However, producers will be tasked with delivering DDGS that is both safe and of good quality to markets around the world.

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