

Case report

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ADVERSE EFFECTS OF WET DISTILLERS GRAINS WITH SOLUBLES (WDGS) IN THE DIET OF DAIRY COWS

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Abstract

Corn wet distillers grains with solubles (WDGS) included up to 25% in the diet of 16 Simmental dairy cows, 27 to 72 months old, during three weeks, negatively affected rumen function monitored by non-invasive parameters, such as fecal consistency, and also influenced milk quality by reducing milk fat content. Dry distillers' grains with solubles (DDGS) are currently the most attractive by-product of the bioethanol industry due to the possibility of application in the diet of various animal species, whereas WDGS is often more locally available and financially affordable; however, there is little data in the literature indicating potential negative consequences of its use. Therefore, this report aims to point out, based on a practical example, the possible problems of its application in the diet of dairy cows as the most metabolically sensitive category, as well as to demonstrate steps to prevent and/or mitigate eventual errors.

Key words: milk fat, ruminal function, sodium bicarbonate, WDGS

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NEGATIVNI EFEKTI SPOREDNOG PROIZVODA PROCESA PROIZVODNJE BIOETANOLA IZ KUKURUZA (DŽIBRE) U ISHRANI MUZNIH KRAVA

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Kratak sadržaj

Vlažni sporedni proizvod destilacije alkohola iz žitarica (kukuruzna džibra) primenjen u količini do 25% u obroku 16 muznih krava simentalске rase, starosti od 27 do 72 meseca, tokom tri nedelje, negativno je uticao na funkciju buraga praćenu neinvazivnim parametrima, kao što je konzistencija fecesa, a takođe i na kvalitet mleka usled smanjenja sadržaja mlečne masti. S obzirom na to da je suva džibra trenutno najatraktivniji sporedni proizvod industrije bioetanola zbog mogućnosti primene u ishrani različitih životinjskih vrsta, ali da je vlažna kukuruzna džibra često lokalno dostupnija i finansijski pristupačnija, kao i da je u literaturi malo podataka koji ukazuju na potencijalne negativne posledice njene upotrebe, cilj ovog izveštaja je da na osnovu praktičnog primera ukaže na moguće probleme primene u ishrani mlečnih krava kao metabolički najosetljivije kategorije, kao i da demonstrira korake za preveniranje i/ili ublažavanje eventualnih grešaka.

Cljučne reči: džibra, mlečna mast, natrijum bikarbonat, ruminalna funkcija

CASE PRESENTATION

In the last few decades, the expansion of the production of alternative fuels from plant raw materials, traditionally intended for food, has led to significant changes in the field of the energy industry as well as agriculture and food and feed production. Worldwide, the most pronounced trend is the development of integrated technology in which by-products would be maximally valorized, thus achieving greater productivity with minimal environmental pollution. Dry distillers' grains with solubles (DDGS) currently is the most attractive by-product of the bioethanol industry due to the possibility of application in the

nutrition of cattle, pigs, poultry, and fish (Semenčenko et al., 2013). However, wet distillers' grains with solubles (WDGS) is also used. It is a product obtained after distilling alcohol and before drying to DDGS. It consists primarily of up to 70% moisture, fiber, protein, and fat. In addition to the unchanged starting substances from the raw material, it contains yeast cells and products of yeast metabolism from the fermentation process, such as B vitamins and some growth factors.

The aim of this report is to show a case of the negative effect of the substitution, in dairy cow rations, of traditional protein and starch sources with more sustainable "circular" feeds in order to increase the sustainability of dairy production. For this purpose, 16 mid-lactating (average daily milk production 23.81 ± 4.55 L) Simmental dairy cows, 27 to 72 months old, were blocked and assigned to the 21-day long nutrition treatment based on the addition of WDGS as 25% of the daily meal (which consisted of 6 - 8 kg of 18% crude protein concentrate and 8 kg of silage, plus alfalfa hay ad libitum). The chemical composition of WDGS as a percent of dry matter (% DM) is shown in Table 1.

Table 1. Chemical composition of WDGS (% DM)

Moisture	Ash	Fat	Crude protein	Crude fiber
69.12	0.63	1.97	10.13	3.82

Cows selected for the trial were housed in a naturally ventilated tie-stall barn with individual feed managers and drinkers (water intake ad libitum). They were milked twice a day (08:00 a.m. and 07:30 p.m.), and the daily individual milk production was recorded. The health condition of the animals was monitored daily with particular attention to indicators of digestive disorders (rumen motility and feces appearance). At the beginning of the experiment (day 0), as well as at the end of the treatment (day 21), and on the 42nd day after a three-week break in the use of WGGs, the milk quality (the content of milk fat, protein, lactose, and non-fat dry matter (NFDm)) was assessed using standard chemical methods and registered individually for each cow. Based on the changes in the consistency of cows' excrement through the first weeks, subacute acidosis (SARA) was suspected and then confirmed by the results of the milk tests as a statistically very significant drop in fat content on day 21 compared to day 0 (< 0.01). Daily milk yield (DMY) and protein, lactose, and NFDm content were not affected (Table 2).

Table 2. Daily milk yield (DMY) and milk composition (mean value \pm SD)

Sampling day	DMY [l/day]	Fat content [%]	Protein content [%]	Lactose content [%]	NFDM [%]
0	23.81 \pm 4.55	4.03 \pm 0.20 ^a	3.38 \pm 0.12	4.66 \pm 0.08	9.07 \pm 0.16
21	23.38 \pm 4.15	3.57 \pm 0.41 ^b	3.43 \pm 0.19	4.68 \pm 0.11	9.05 \pm 0.14
42	23.25 \pm 3.57	4.02 \pm 0.12 ^a	3.44 \pm 0.12	4.68 \pm 0.11	9.11 \pm 0.11

^{ab}Values in rows bearing different superscripts differ significantly ($p < 0.01$)

WGGS was removed from the diet at that moment and, although the motor function of the rumen was preserved during the whole trial, and the number of rumen contractions was within the physiological limits of 7 - 14 contractions lasting 5 minutes in all tested cows, each cow received 100 g of sodium bicarbonate daily (divided into morning and evening doses) up to 42nd day to treat subacute acidosis, i.e. to neutralize rumen acidity and correct pH. During the mentioned period, milk quality was restored, so milk analyses on the 42nd day indicated recovery of milk fat content (Table 2) and other SARA symptoms.

The basic statistical analysis was done in Excel, and a comparison of statistical significance was performed by t-Test (Paired Two Sample for Means).

DISCUSSION

WDGS are sold prior to drying. Traditional wet distillers grains contain 30 to 35% DM and are similar in nutrient composition to DDGS, but they can vary considerably. WDGS are often lower in price on a dry matter basis compared to DDGS, but the producer must determine that WDGS can be successfully used in his/her operation. There are benefits of using WDGS, mainly because of their high palatability and how they condition very dry diets. Total mixed rations that contain 10 to 20% WDGS maintain greater homogeneity as dry particles stick together. From a practical standpoint, this results in less particle separation and less sorting by cattle. Methods to conserve and equipment to handle WDGS on the farm are among the challenges producers often face (Kalscheur and Garcia, 2019).

Despite being a potentially good option for economic and quality reasons, the high moisture content of WDGS imposes storage, transport, and high perishability constraints on farmers (Anderson et al., 2015; Moyo et al., 2016;

Ranathunga et al., 2018). Such consistency easily results in the formation of mold and quality decrease after four days under normal handling conditions (Souza et al., 2016; Moyo et al., 2016). Drying WDGS (40 – 70% moisture) to produce dried distillers' grains with solubles (DDGS, 10 – 13% moisture) is costly, and the heat processing during drying can make DDGS more susceptible to protein damage and lead to poor amino acid availability (Cao et al., 2009).

The nutrient content of DGS is influenced by factors such as the type and quality of the grain, milling, and fermentation processes. WDGS is low in effective fiber content (cellulose), which, together with excessive shredding and due to a sudden change in diet, as well as a disturbed ratio of the concentrated and roughages of the meal, leads to the development of subacute acidosis.

As explained in the paper of Kitkas et al. (2019), consequences of SARA in dairy cows may include a decrease in milk fat due to changes in rumen fermentation and fatty acids profile. Low ruminal pH alters rumen bacteria populations and fermentation patterns, favoring the production of specific long-chain fatty acids (LCFA) inhibit milk fat synthesis in the udder after absorption. Statistically highly significant (< 0.01) drop in milk fat content between 0 and 21st day of our treatment with 25% of WDGS is not in compliance with the findings of Kavitha et al. (2021), who concluded that WDGS could be included up to 35% of DM requirement with no adverse effect on milk yield and composition of the crossbred cows for economical production. A similar positive statement was reported by Mammi et al. (2022), who found out that the rational inclusion of wheat distillers in properly formulated rations represented a safe opportunity to reduce the environmental impact of dairy farming while maintaining high production levels.

In our case, the negative impact on milk composition appeared as a consequence of the development of acidosis, which most likely occurred due to the inadequate quality of the feedstuff itself, which was used without prior analysis. After tests were carried out in order to determine the cause of the rumen disorder, it was determined that the used WDGS had an unexpectedly poor composition (Table 1) and that the appearance of acidosis most likely occurred due to the lack of effective fibers in the cow's ration (Arias et al., 2012).

This situation was overcome by the removal of WDGS from the diet of dairy cows and by simultaneous intervention with sodium bicarbonate. Rumen buffering is a common practice on dairy farms, although various products are designed for this purpose. Cruywagen et al. (2015) observed in their experiment that the inclusion of buffer in the diet of lactating cows has a positive effect on milk production and milk composition, which is in agreement with the case experience presented here.

As stated by Kalscheur and Garcia (2019) and confirmed within our farm case, when formulating animal diets, knowing the accurate nutrient composition of DGS is critical. Laboratory testing of purchased DGS is highly recommended, although only sometimes practical for some shipments. One of the challenges is finding complementary feeds that will compose an appropriate meal. Fibrous residues such as corn stover, straw, and roughages with low concentrations of total digestible nutrients are ideal feedstuffs to complement a diet that includes ethanol by-products. Blending WDGS with forages creates a complementary nutrient profile by enhancing higher physically effective fiber (Arias et al., 2012), while co-ensiling WDGS with whole-plant maize provides the opportunity for the long-term storage and utilization of WDGS (Moyo et al., 2022).

Finally, it is necessary to emphasize once again and conclude that any sudden change in the diet, especially of dairy cows, as a category with the most sophisticated metabolic requirements, implies a preliminary analysis of the ingredients and the ratio as a whole. Ad hoc reaching for more available and/or affordable solutions often costs much more.

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Author's Contribution:

KN and MN made contributions to conception and design of the study, involved in data collection, and drafting the manuscript. AT carried out the chemical analysis. KN prepared the final draft of the manuscript, while MN and AT revised the manuscript critically. All authors read and approved the final manuscript.

Competing interest

The authors declare that they have no competing interests.

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