Journal of Research in Ecology

An International Scientific Research Journal

ISSN No: Print: 2319 –1546; Online: 2319– 1554

Original Research

The effect of different levels of dried distillers wheat grain with solubles on milk composition, blood parameters and concentration of liver enzymes in holstein cows during the transitional period

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ABSTRACT:

In order to evaluate the effect of different levels of wheat Dried Distillers Grain with Solubles (DDGS) on milk composition, blood parameters and concentration of liver enzymes in dairy cows during the transitional period, 12 Holstein dairy cows with similar porosity, weight and record are studied for six weeks in a completely random design. The cows received experimental treatments for three weeks before calving, three weeks after calving and two weeks and represented 0, 50, 100% of wheat DDGS as soybean substitute. The experimental cows were milked three times a day at 4 a.m., 12 p.m. and 8 p.m. The blood samples were taken two weeks after the experiment, two weeks after calving and after morning diet. The results of the study showed that using wheat DDGS milk production was maintained but with negative effect on fat of milk. All blood measures were constant and only urea of blood plasma was increased. As aspartate aminotransferase enzyme and liver creatine phosphokinase of plasma are not changed, wheat DDGS supplement can be used without having any negative effect on liver activity during the transitional period on dairy cows.

Keywords:

Distillers grain with solubles, wheat, milk composition, blood parameters, dairy cows, transitional period.

Article Citation:
Mohammad Hadi Aghajani Delavar, Yadollah Chashtidel and Asadollah Teimuri Yansari
The effect of different levels of dried distillers wheat grain with solubles on milk composition, blood parameters and concentration of liver enzymes in holstein cows during the transitional period
Journal of Research in Ecology (2016) 4(2): 412-419

Web Address:
http://ecologyresearch.info/documents/EC0197.pdf

Dates:
Received: 16 Nov 2016 **Accepted:** 24 Nov 2016 **Published:** 31 Dec 2016

Journal of Research in Ecology

INTRODUCTION

Dried Distillers Grain with Solubles (DDGS) is the second main product of green fuel production. The applied grains for ethanol (wheat, corn, barley and sorghum) consisted of 60-62% starch. The starch content of these grains are converted into dehydrated bioethanol after hydrolysis, fermentation, distillation and dehydration. Fuel production has been progressed over time and the supply and demand of distilled grains are increased. Annually, DDGS was produced about one million ton in 1998 and about 10 million tons in 2006. DDGS is used in animal feeds as humid and dry (Spice *et al.,* 2002).

In US National Research Council (NRC, 2001), it is stated that DDGS has good uniform quality and this showed the increased efficiency and fermentation of new generation of plants to extract ethanol. For a long period, DDGS has been used as a substitute for corn grain and soya bean press cake to provide energy and protein. The substitution is based on the determination of the experts on diet, type of animals, birds, fish and comparison of the price of DDGS, soybean press cake, other oil press cakes and corn grain (Holman, 2007).

In the life of dairy cows, no period is much important than transitional period- during the late pregnancy to the early lactation. At the end of this critical period, the cow intake is at the lowest value during lactation and by nutritional solutions, we can reduce metabolic problems of animal in this period. The transitional period consisted of three weeks before calving and three weeks after calving. The term transitional period is due to physiological, metabolic and nutritional changes in this period. Transitional period in dairy cow is the most risky time to increase metabolic and infectious diseases. Metabolic diseases are associated with nutritional management during dryness and the early lactation periods as the cow transits from a stage in low need of energy and maintenance to a stage in which production efficiency is increased. The nutritional management of transitional cows are taken into attention due to their significance in milk production and health of cow in the most of the researches. The correct management during transitional period is a key success of lactation period and it is used to increase milk production during 5-6 weeks after calving. In the three final pregnancy weeks, the cow needs high level of energy and protein. Rapid increase of the requirements of the fetus, growth of mammary gland and production of milk composition are the important factors. This increased requirement leads to reduction of food intake in the final weeks of pregnancy. After pregnancy, the diet is not consistent with the production and this is of great importance in continuance of physiological changes. For consistency of physiological and hormone changes of the body, life plays an important role. Due to the importance of liver in metabolism of sugar, fat and proteins, the organ should work well during the transitional period (Orton, 2004). Sulfuric acid is used to keep pH at definite level in the fermentation dishes. Grains are used in ethanol production and distilled grains have little sulfur. This amount of sulfur is harmless for the cows unless it is used in the high level of diet (Space *et al.,* 2002). High amount of sulfur is harmful for urinary tract and liver and other types of feeding can reduce the weight and milk production (Kole *et al.,* 2006).

This study evaluates the effect of different levels of wheat Dried Distillers Grain with Solubles (DDGS) on milk composition, blood parameters and concentration of liver enzymes, in Holstein cows during the transitional period.

MATERIALS AND MRTHODS

Treatments and experiment diets

12 Holstein dairy cows with similar porosity, weight and record are studied for six weeks in a completely random design. The cows received experimental treatments for three weeks before calving and three weeks after calving and two weeks and represented 0, 50, 100% of wheat DDGS as a soybean

substitute. The cows were in groups. The cows bedding was covered with sand with the depth of 15cm at the end of place every day and the dirty parts were cleaned. No bedding was used in the frontal part. The place is closed and bright during the night. The diet in this study is based on the pure system of carbohydrate and protein of Kernel University (Fox *et al.,* 2000), (Tables 1 and 2). The diets were distributed daily as free intake (for 5 to 10% after feeding) as Total Mixed Ration (TMR) in two times (at 6.5, 18.5) with equal values. The feed was used as the residual and didn't exceed 10% of the intake (based on as fed).

Evaluation of milk production and determination of its composition

The experimental cows were milked three times in a day at 4 a.m., 12 p.m. and 8 p.m. The produced milk was recorded and sampled. The samples of each cow were mixed based on the produced milk of the same day. To determine protein, fat, lactose and total solid with milkoscan (133 B Denmark, N. FOsS), the samples were sent to milk laboratory.

Blood samples and liver enzyme measures

The blood samples were taken via caudal vein after two weeks of experiment, two weeks after calving, three hours after morning diet. The measures including

Table 1. Percent of the diet components in different levels of DDGS before calving

Sl. No	Feedstuff (%)	Diet 1	Diet 2	Diet 3
1	Dry hay	33.5	33.5	33.5
2	Corn silage	24.8	24.8	24.8
3	Wheat bran	16.5	16.5	16.5
4	Corn grain	8.5	8.5	8.5
5	Barley grain	4.5	4.5	4.5
6	Soybean press cake	0	5	10
7	DDGS	10	5	0
8	Crushed what straw	1.7	1.7	1.7
9	Mineral-vitamin supplement	0.5	0.5	0.5
10	Crude protein %	13.3	13.3	13.3
11	Pure energy of lactation (mega calorie per kg dry matter)	1.6	1.6	1.6

Table 2. Diet components in different levels of DDGS among Holstein cows

Sl .No	Foodstuff (%)	Diet 1	Diet 2	Diet 3
1	Corn silage	20	20	20
2	Dry hay	17.5	17.5	17.5
3	Corn grain	12	12	12
4	Barley grain	18.5	18.5	18.5
5	Soybean press cake	15	7.5	0
6	DDGS	0	7.5	15
7	Rapeseed press cake	7	7	7
8	Fat	2	2	2
9	Beet pulp	1.5	1.5	1.5
10	Fish powder	1.3	2.3	3.3
11	Wheat bran	4	3	2
12	Mineral+vitamin supplement	0.75	0.75	0.75
13	Dicalcium phosphate	0.25	0.25	0.25
14	Salt	0.2	0.2	0.2
15	Crude protein %	16.2	16.2	16.2
16	Pure energy of lactation (mega calorie per kg dry matter)	1.81	1.81	1.81

Table 3. The comparison of the effect of wheat DDGS in feed during transitional period of Holstein dairy cow on blood measures before calving

Sl. No	P value	Parameters	Group 1-level 0% of Wheat DDGS as substitute of soybean (Mean ±SD)	Group 2-level 50% of Wheat DDGS as substitute of soybean (Mean ±SD)	Group 3-level 100% of Wheat DDGS as substitute of soybean (Mean ±SD)
1	0.556	Glucose (mg/dl)	56.3±5.7	51.0±8.6	51.8±6.9
2	0.143	Urea (mg/dl)	23.5±4.7	29.0±3.7	28.3±3.0
3	0.985	Triglyceride (mg/dl)	97.0±10.5	96.0±10.0	96.8±2.5
4	0.990	Cholesterol (mg/dl)	115.5±14.3	116.3±11.4	115.0±12.5
5	0.920	Lipoproteins with high density (HDL) (mg/dl)	28.0±6.0	27.3±8.1	26.3±3.1
6	0.981	Lipoproteins with low density (LDL))(mg/dl)	26.3±10.6	27.5±9.3	27.0±7.1
7	0.765	Total plasma protein (g/dl)	8.4±0.9	8.6±1.0	8.9±0.9
8	0.987	Albumin (g/dl)	3.7±0.6	3.6±0.4	3.7±0.5
9	0.995	Globulin (mg/dl)	4.3±0.3	4.3±0.4	4.3±0.5
10	0.966	Beta hydroxybutyric acid (mg/dl)	0.7±0.1	0.7±0.0	0.7±0.1
11	0.066	Aspartate aminotransferase enzyme (IU/L)	70.5±8.2	83.5±3.7	86.3±12.1
12	0.992	Liver creatine phosphokinase (CPK) (IU/L)	113.2±27.2	114.7±14.9	113.5±7.9

glucose, triglyceride, cholesterol, High Density Lipoproteins (HDL), Low Density Lipoproteins (LDL), total plasma protein, albumin, globulin, beta hydroxybutyric acid and Ammoniacal nitrogen were carried out. The samples were taken using a vacuum tube and were transferred with ice to a laboratory. After serum isolation, the obtained serums were poured into micro tubes 1.5cc and were kept at the temperature 20^0C until analysis of blood samples. The concentration of glucose, triglyceride, cholesterol and HDL of plasma was calculated using a diagnosis kit by photometric method (Jin *et al.,* 2012). Aspartate Aminotransferase Enzyme (AAE) and Liver Creatine Phosphokinase (LCP) were measured by commercial kits in the laboratory.

The present study is carried out in a completely random design with three treatments and four replications. The data are analyzed using SPSS, V.16 and the means are compared by Duncan test at the significant level 0.05.

Test used:

Xij = μ+Ti+eij

where,

Xij: Observation in experiment

μ: Total mean

Ti: Treatment effect

Eij: Experiment error effect

RESULTS AND DISCUSSION

Blood measures

The data of blood analysis and liver enzymes before and after calving are shown in Tables 3 and 4.

The concentration of blood urea in the treatments using DDGS after calving was higher than that of control treatment. Chimisa (2013) and Klassen (2016) reported similar results. The increase of urea in DDGS treatments is due to high level of sulfur provided as supplement with this feed in rumen and thus increases sulfide production instead of entrapping nitrogen to make microbial protein having negative effect on microbes; protein digestion is also disturbed and urea is increased. Generally, by increasing sulfur level in rumen, azotemia is created and it

Table 4. The comparison of the effect of wheat DDGS in feed during transitional period of Holstein dairy cow on blood measures after calving

Sl. No	P value	Parameters	Group 1-level 0% of Wheat DDGS (Mean ±SD)	Group 2-level 10% of Wheat DDGS (Mean ±SD)	Group 3-level 20% of Wheat DDGS (Mean ±SD)
1	0.731	Glucose (mg/dl)	56.3±6.4	52.8±9.8	51.8±8.3
2	0.004	Urea (mg/dl)	*26.0±2.9	*33.3±2.1	33.3±2.6
3	0.985	Triglyceride (mg/dl)	97.0±10.5	96.0±10.0	96.8±2.5
4	0.990	Cholesterol (mg/dl)	115.5±14.3	116.3±11.4	115.0±12.5
5	0.957	Lipoproteins with high density (HDL) (mg/dl)	74.0±5.2	73.0±3.4	73.3±5.9
6	0.920	Lipoproteins with low density (LDL) (mg/dl)	28.0±6.0	27.3±8.1	26.3±3.1
7	0.765	Total plasma protein (g/dl)	8.4±0.9	8.6±1.0	8.9±0.9
8	0.987	Albumin (g/dl)	3.7±0.6	3.6±0.4	3.7±0.5
9	0.995	Globulin (mg/dl)	4.3±0.3	4.3±0.4	4.3±0.5
10	0.991	Beta hydroxybutyric acid (mg/dl)	0.6±0.0	0.6±0.1	0.6±0.1
11	0.057	Aspartate aminotransferase enzyme (IU/L)	82.0±7.1	89.8±2.8	92.8±5.8
12	0.991	Liver creatine phosphokinase (CPK) (IU/L)	115.5±23.8	115.5±15.4	117.0±12.9

* (Group 1 with 2: P value - 0.010)

gathers azoth in blood and the kidneys have pressure in eliminating urea and creatine and are increased in the blood (Kaneko, 2008 and 2011). There was no significant difference in the evaluation of other blood measures.

Concentration of Aspartate Aminotransferase Enzyme (AAE) showed no significant change in plasma. Treatment of natural range of this enzyme in dairy cows was about 78-132 unit/lit (Kaneko, 2008; Moneydary, 2011). Based on these researches, despite the increase of aspartate aminotransferase enzyme, its changes didn't exceed the allowed level for dairy cows and there found no serious injury on the liver of the animal. The comparison of the mean of plasma concentration of Creatine Phosphokinase Kinase enzyme (CPK) of blood serum before and after calving, showed no significant difference among the treatments. Liver enzymes are liver activity indices and their increase or decrease showed the physiological condition of liver and that of the animal (Vanhosen, 1991). It is observed that the mean of treatments after calving is the same as the pre-calving process.

Milk composition and production

The results of the production and composition of milk are shown in Table 5.

The milk production of DDGS treatments had no significant increase. The previous study showed that

Table 5. The comparison of the effect of wheat DDGS in the feed during transitional period of Holstein dairy cow on milk production and its composition

Sl. No	P- Value	Variables	Group 1-level 0% of Wheat DDGS	Group 2-level 10% of Wheat DDGS	Group 3-level 20% of Wheat DDGS
1	0.271	Total produced milk (kg/day)	25.9±4.2	3.1±30.0	4.0±29.8
2	0.818	Protein (%)	2.7±0.2	0.4±2.7	0.2±2.6
3	0.008	Fat (%)	*3.9±0.4	0.2±3.0*	0.2±3.3
4	0.828	Lactose (%)	4.8±0.3	0.3±4.8	0.3±4.7
5	0.673	Solid matter (%)	11.9±0.1	0.2±12.0	0.2±12.0

* (Group 1 with 2: P value - 0.008)

DDGS feed of corn in about 20% of dry matter intake increased milk production (Leonardi *et al.,* 2005; Anderson *et al.,* 2006; Kleinschmit *et al.,* 2006).

In some researches, DDGS application had no effect on milk production (Hippen *et al.,* 2004; Abdolghader *et al.,* 2009). The fat in milk in the second treatment had significant reduction compared to other treatments. Leonardi *et al.* (2005) showed that the increase of DDGS level reduced the milk fat linearly. In conflict with this view, in another study, it was reported that corn feed of DDGS at 20% of dry matter in diet had no effect on the fat concentration of milk (Anderson *et al.,* 2006; Kleinschmit, 2006).

Pump *et al.* (2006) tested DDGS with soybean press cake as a supplement and substitute of protein in the diet of dairy cows. The results showed the similar and higher production in milk production of Holstein dairy cows. In a similar test done by Powers *et al.* (1995), when there was equal fat and protein diet of dairy cow, the milk production was similar and higher than the soybean press cake diet in control group. Schingoethe *et al.* (2009) showed that DDGS was used in the diet and to keep the milk fat, the fodder should be fed to keep the effective fiber of the diet to avoid reduction of milk fat. The significance of fiber of fodder to reduce DDGS effect on milk fat was verified by Zhang *et al.* (2010). Instead of barley fodder, wheat DDGS was used and the milk fat was reduced.

The protein of milk and total solid showed no difference in treatments (Mpapho *et al.,* 2006). A test was carried out in which dairy cows were fed with DDGS at 15% of dry matter for total lactation period. The feeding with this amount of DDGS during the dryness and transitional period was continued and it led into the second period of lactation. After the first year, the difference in milk production was 31.7kg for control and 33.6kg for the diet of 15% DDGS. The fat percent was 3.75% and 4.07% respectively. The protein percent was 3.29 and 3.41% respectively and it showed no significant reduction. There was no significant difference between other milk measures including lactose and total solid.

CONCLUSION

The results of study showed that using wheat DDGS for milk production, it had negative effect on the milk fat. All blood measures were constant and only urea of blood plasma was increased. Aspartate aminotransferase enzyme and liver creatine phosphokinase were not changed. Wheat DDGS supplement can be used without having any negative effect on liver activity during dairy cows transitional period. Generally, using wheat DDGS instead of soybean in the diet of dairy cows can reduce the costs of food and it can be used as a good protein source in the diet of dairy cows during transitional period.

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