notes on goats

FEEDING VALUE OF WHOLE COTTO ATS

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Almost 8 million tons of cottonseeds with a product value of $
in the U.S. in 2005. Most of the cottonseeds are produced in the
U.S. Texas with almost three million tons valued at $300 million le
Alabama with 275 thousand tons valued at $25 million ranked 10th

Whole cottonseed is a term used to describe the fuzzy seed from varieties of cotton plants. Linted cottonseed does not undergo natural delinting process. Mechanical and acid treatments are the two processes used for delinting cottonseed. The processing of the cotton plant results in a varieties of by-products of gining (gin trash, gin motes, and whole cottonseed), cottonseed processing (delinted cottonseed hulls, cotton linters and cottonseed meal) and cotton textile milling (cleaning and carding waste, cotton mill sweeps, and cotton mill dust). Easiflo cottonseed processing is a technique where the fuzzy whole cottonseed passes through a patented process to glue the linter to the seed for ease of handling and mixing. A 2% gelatinized cornstarch is used to form the crust on the seed. The feeding value of coated cottonseed is identical to fuzzy cottonseed; however, an increase in DM intake has been observed.

Whole cottonseed and other cotton by-products contain gossypol, a yellow polyphenolic compound indigenous to the cotton plant. The concentration of free gossypol in feedstuffs such as whole cottonseed and cottonseed meal varies considerably. Level of gossypol in the seed is about 0.7 to 0.8 % and its concentration can be affected by soil conditions, levels of fertilizer applied, water supply and any factor that may affect plant growth. In nature gossypol exist in two forms, free and bound. The free form is toxic and bound form considered non toxic; however, gossypol can be freed in animal's digestive tract. Gossypol also exists in two isomers referred to a + and – gossypol. The negative gossypol appears to have more biological activities and responsible for its toxic effects. The diet of the animal tends to play an important role in the development of toxicity with high concentrate rations having higher incidents. Animals also can tolerate high levels of free gossypol in the seed rather than meal form of cottonseed. Free gossypol in cottonseed will have slower release compared with the meal. Non ruminant animals are sensitive to the toxic effects of gossypol, whereas ruminants are somewhat resistant. The sign of toxicosis include labored breathing, decrease growth rate, and anorexia. Long term feeding cottonseed to bulls reduced semen volume and characteristics; however, feeding vitamin E at 4000 IU improved the symptoms. Red blood cell fragility has been used as an early indicator of gossypol toxicity in cattle (Calhoun et al., 1990). Red blood cell fragility occurs when mature ruminants ability to detoxify gossypol has been exceeded. Recommended levels of cottonseed in the diet of mature cows and weaned calves are 0.5% and 0.33% of body weight. Feeding 0.5 lbs. of cottonseed per day to Angora goats increased red blood cell fragility (Calhoun et al., 1990).

Case Study

Animals and Diets

An experiment was conducted at Tuskegee University George Washington Carver Agricultural experiment station using 12 Nubian buck kids. The kids were randomly assigned to three different treatments and fed 50% concentrate mix and 50% bermudagrass hay (BGH). Concentrate mixes were made of 1) 50% grain mix (GM) with 0% whole cottonseed (WCS; Easiflo), as control, 2) 35% GM and 15% WCS, and 3) 20% GM with 30% WCS. All animals were treated for internal parasites and control diet

was fed to all animals during the first 4 weeks. Baseline information was collected at this time. Animals were on this experiment for 24 weeks.

Data Collection

Several measurements were taken. Animals were weighed initially and every four weeks. Feed offered and refused was monitored. Blood samples were collected to determine gossypol concentration in plasma, fragility of red blood cells and other hematological parameters and serum chemistry.

Results

Table 2 represents the ingredients of the diets fed to goats. As whole cottonseed increased from 0 to 30% in the diet, corn and soybean meal decreased to less than half. All diets provided the nutrients needed for maintenance and growth of young goats. Both WCS diets provided higher fat and diet containing 30% WCS provided slightly higher protein and fiber.

Table 2. Ingredients and nutrient composition of diets consumed by goats

Ingredient, % of DM	
Composition of concentrate mix, % of DM	
EasiFlo Cottonseed	
Ground Corn	
Soybean meal (48% CP)	
Trace mineralized salt	
Molasses (Black strap)	
Vitamin A, D, E mix[b]	
Chemical analysis, %[c]	
DM	
CP	
Ether Extract	
Non-fiber carbohydrates [d]	

Table 3. Performance and intake of goats consuming various levels of WCS

Item	WCS %			SEM	*P*-value [a]	
	0	15.5	32.7		Linear	Quadratic
Body Weight, kg						
Initial	26.1	24.0	25.6	1.02	0.74	0.16
Final	38.3	40.4	38.5	1.51	0.94	0.30
Average Daily Gain, g	81.4	109.8	85.7	6.83	0.66	0.01
Feed Intake, g of DM	948.3	1295.6	1084.7	103.0	0.37	0.05
G:F	0.09	0.09	0.08	0.01	0.70	0.84

[a] Based on orthogonal contrast for equally spaced treatments.

Gossypol intake as percent of dry matter or as a function of body weight increased as WCS increased in the diets (Table 4). Total gossypol and both forms of gossypol increased in plasma as WCS increased in the diets; however, fragility of red blood cells did not follow the same trend. Fragility of red blood cells did not change by feeding 15% WCS to goats; however, 30% WCS in the diet increased red blood cells fragility. This table confirms that although 15% WCS increased gossypol level in the plasma but it did not have harmful effect on red blood cells.

Table 4. Gossypol intake, plasma gossypol and erythrocyte fragility of goats consuming various levels of WCS

Item	WCS %			SEM	*P*-value [a]	
	0	15	30		Linear	Quadratic
Gossypol intake						
mg/kg DM	0.0	0.54	1.41	0.03	0.0001	0.001

was lower when animals consumed WCS in their diets. Normal sperms and progressive motility were lowered; however, sperm head, mid piece and tail abnormality were increased by adding WCS to diets. Following data indicates that WCS did affect reproductive performance of young bucks and should be fed sparingly to young bucks. If young bucks are raised as the replacement herd sires, extreme percussions must be taken when feeding WCS in the diet.

Table 5. Scrotal circumference and semen quality of goat kids consuming whole cottonseed (WCS)

	WCS %				*P*-value [a]	
Item	0	15	30	SEM	Linear	Quadratic
Scrotal circumference, cm	23.1	22.3	20.4	0.31	0.0001	0.22
Semen quality						
Volume, mL	0.44	0.43	0.54	0.06	0.30	0.45
Concentration, ($x10^6$/mL)	440.4	300.9	427.6	35.2	0.80	0.01
Sperm quality						
Normal, %	81.0	73.9	71.5	6.1	0.30	0.76
Gross motility (scale 0-5)	4.90	4.52	4.56	0.11	0.05	0.16
Progressive motility, %	72.3	67.2	59.2	5.89	0.14	0.84
Head abnormality, %	8.24	4.56	15.41	5.80	0.40	0.33
Mid piece abnormality, %	9.49	10.6	12.1	2.84	0.54	0.96
Tail abnormality, %	2.52	2.83	4.62	1.36	0.32	0.67

[a] Based on orthogonal contrast for equally spaced treatments.

Blood cell counts. No differences in red blood cell counts, white blood cell counts or differential counts were observed between animals fed different diets; however, hematocrit of goats on 30% WCS diet decreased (Table 6).

Table 6. Hemogram of goat kids consuming various levels of whole cottonseed (WCS)

	WCS %				*P*-value [a]	
Item	0	15	30	SEM	Linear	Quadratic
Red Blood Cell, 10^6/µL	13.9	14.3	13.3	0.54	0.29	0.17
Hematocrit, %	27.5	28.9	25.1	0.94	0.08	0.03
White Blood Cell,10^3/uL	14.8	16.1	14.3	0.74	0.64	0.10
Neutrophils	62.2	64.0	56.2	3.45	0.23	0.26
Lymphocyte	35.6	33.8	40.9	3.60	0.30	0.32

[a] Based on orthogonal contrast for equally spaced treatments.

Blood nutrients, enzymes and minerals are presented in Table 7. Diets containing WCS did not affect most blood metabolites or liver related enzymes; however, blood protein and creatine increased as the level of WCS increased in the diets. Protein in the diets containing high levels of WCS was higher and that may have affected this change. This data indicates that WCS did not affect blood metabolites or liver related enzyme and may be fed to growing animals raised for meat and milk.

Table 7. Blood metabolites of goat kids consuming various levels of whole cottonseed (WCS)

	WCS %				*P*-value [a]	
Item	0	15	30	SEM	Linear	Quadratic
Plasma enzymes, IU/L						
AST *	73.0	67.6	70.1	5.52	0.70	0.54
Gama glutamyletransferase *	59.6	53.6	51.9	5.65	0.36	0.76
Protein, g/dL	5.96	6.20	6.54	0.18	0.02	0.80
Albumin, g/dL	3.77	3.77	3.95	0.16	0.44	0.65
Bilirubin, mg/dL	0.08	0.12	0.11	0.03	0.64	0.52
Creatine, mg/dL	0.65	0.82	0.93	0.08	0.02	0.77
Blood Urea Nitrogen, mg/dL	29.9	30.6	33.9	1.90	0.16	0.58
Glucose, mg/dL	52.2	58.5	44.0	4.43	0.21	0.06
Blood minerals, mg/dL						
Calcium	7.21	7.60	8.04	0.33	0.10	0.96
Phosphorous	6.79	6.52	6.80	0.42	0.98	0.60
Blood electrolytes, mEq/L						
Sodium	148.1	147.4	152.0	1.57	0.09	0.18
Chloride	111.8	111.0	111.0	1.32	0.67	0.81
Potassium	5.38	5.82	5.85	0.18	0.30	0.98

[a] Based on orthogonal contrast for equally spaced treatments.
* Liver enzymes

Conclusions

Whole cottonseed is a by-product of cotton industry and is produced in large quantities mainly in the Southeast and West of the U.S. It has high fat and protein contents and can increase protein and energy density of the diets for ruminants while reducing the cost of production. Inclusion of WCS at the level of 15% of the diet increased dry matter intake and gain with no adverse effects on blood metabolites and liver related enzymes. Whole cottonseed contains gossypol that at high levels (30%) increased red blood cell fragility and reduced reproductive performance of young bucks. Scrotal circumference and semen concentrations were reduced. Sperm normality and progressive motility were adversely affected, where as sperm abnormalities were increased by addition of WCS to the diets.

Whole cottonseed at 15% of the total diet can be safely used for meat goat production; however, it should not be fed or fed very sparingly to young bucks raised for breeding purposes.

References

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USDA-NASS. National Agriculture Statistic Service.
(http://usda.mannlib.cornell.edu/reports/nass/livestock/pls-bban/lsan0305.pdf)

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