EFFECTS OF COUMESTROL AND DIETHYLSTILBESTROL ON THE ORGANOLEPTIC QUALITY OF LAMB

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ALTHOUGH Moule et al. (1963) have very adequately summarized data on reproductive disturbances and problems resulting from cattle and sheep grazing estrogenic pastures, relatively little research has been reported on the effects of the native estrogen, coumestrol (Bickoff et al., 1958), on the growth response and carcass quality of ruminant animals (Johnston and Anglemier, 1963; Oldfield, 1961; Stob et al., 1964). Moreover, the literature is almost void of information concerning the eating quality of meat produced from animals fed coumestrol, except for the preliminary reports of Fox and Oldfield (1962) and Oldfield and Fox (1963).

On the presumption that many grazing animals are exposed to varying but biologically significant quantities of this estrogen, some evaluation of its effect on the quality of the product is deemed necessary.

The research reported herein pertains to the effects of feeding different levels of dietary coumestrol on the organoleptic quality of lamb. Also investigated were the effects of diethylstilbestrol (DES) implantation superimposed on the coumestrol treatments.

Experimental

Fifty wether lambs were randomly divided into five lots of 10 animals each. The average weight of the animals was 39.1 kg., and their ages were estimated to range from 140 to 160 days. At the start of the test, five animals of each lot were implanted with a 3-mg. pellet of diethylstilbestrol. Each lot was fed a standard basal pelleted ration composed of 55% dehydrated alfalfa meal, 30% ground barley and 5% cane molasses. The coumestrol concentrations were 18, 51, 114, 151 and 132 ppm in the diet dry matter for lots 1, 2, 3, 4 and 5, respectively. For lots 2, 3 and 4, the coumestrol concentrations were achieved by adding to the basal ration calculated amounts of acetone extract of alfalfa. The dehydrated alfalfa meal used in the rations for lots 1 through 4 contained a low level of coumestrol (18 ppm), whereas that used for lot 5 had a high native coumestrol content of 132 ppm.

The animals were fed ad libitum for 56 days. The average daily dietary coumestrol intake was approximately 56, 167, 336, 445 and 521 mg. per lamb for lots 1 through 5, respectively.

All lambs were slaughtered within 48 hr. of termination of the feed test at an average slaughter weight of 52.7 kg. The carcasses were aged at 3° C. for 5 days. From each carcass a rack (5th through 12th ribs) was removed, double-wrapped and quick-frozen. Within 3 weeks the frozen rack of each lamb was placed in a gas oven set at 163° C. and roasted until the internal temperature of the loin muscle reached 81° C. The temperature of the roast increased 2° C. after the rack was removed from the oven. After cooking an intact longissimus dorsi muscle was taken from each rack, and eight slices 6 mm. in thickness were removed from the center of the muscle by a mechanical slicer cutting perpendicularly to the longitudinal axis of the muscle. These slices were evaluated by a trained taste panel consisting of eight members, who scored the meat for flavor, tenderness and juiciness on a seven-point descriptive scale ranging from 7 (very pronounced flavor, very tender, very juicy) to 1 (imperceptible flavor, extremely tough, extremely dry) in half unit divisions.

Tenderness was also measured objectively by the use of a recording Kramer-type shear press (Bailey et al., 1962). To obtain this measurement of tenderness the matching longissimus dorsi muscle of each cooked rack was sliced as described above. After removal of both external fat and connective tissue, the force that was required to shear a 20-gm. sample of the loin muscle was determined. The first shear was performed with the muscle
fibers lying parallel to the stroke of the shearing device. The meat fragments were then returned to the sample holder in a random manner, lightly leveled and sheared again. This latter procedure was repeated a second time. The three measurements were averaged and the results expressed as kilograms of shear force per gram of sample. Analysis of variance and the multiple range test were used to evaluate the results statistically.

Results and Discussion

Flavor differences among all treatments were not significant, indicating that coumestrol within the range of levels investigated, alone or in combination with DES, imparted no effect on the flavor of the meat.

Figure 1 presents the average taste panel scores and shear value data of the cooked loin muscles for each of the five lots of lambs fed varying levels of coumestrol (nonimplanted groups). The average taste panel scores for tenderness were 4.02, 4.82, 4.94, 5.30 and 5.56, while the mean shear force values were 7.32, 5.04, 5.32, 4.84 and 4.35 for lots 1 through 5, respectively. It should be mentioned that the shear force values are inversely related to panel tenderness scores.

There was a correlation coefficient of -.84 between all taste panel scores for tenderness and the shear force data. Lambs of lot 1, fed the lowest level of coumestrol (18 ppm), produced meat that was judged significantly (P<.01) less tender than that from lambs of the four other lots. Differences in tenderness scores and shear force values among lots 2, 3, 4 and 5 were not significant.

Average taste panel scores for juiciness were 4.16, 4.46, 4.36, 4.76 and 4.90 for lots 1 through 5, respectively. The average juiciness scores for the meat from lambs of lots 4 and 5 were significantly (P<.05) higher than that for lot 1. Moreover, the juiciness scores closely paralleled both shear and panel evaluations for tenderness among lots.

The meat rated highest for tenderness and juiciness was obtained from the lambs of lot 5, which were fed the diet containing dehydrated alfalfa meal having a high coumestrol content (132 ppm). Moreover, animals in lot 5 had the highest daily coumestrol consumption (521 mg./lamb). Although the source of coumestrol may have had some effect in producing juicier and more tender meat, the influence of the high level of coumestrol ingestion appears to be the primary cause for the noted increase in organoleptic quality.

![Figure 1](image-url)

**Figure 1.** Effects of dietary coumestrol on the meat quality of lamb. Numbers above each group of points refer to animal lots.
The meat evaluation data presented in figure 2 graphically depict the effects of DES implantation superimposed over the coumestrol treatments. The average taste panel tenderness scores were 4.56, 4.88, 5.62, 4.62 and 4.68, and the mean shear values were 5.49, 5.14, 6.47 and 5.71 for lots 1 through 5, respectively. Analysis of variance of panel tenderness scores indicated that differences among the five lots were not significant; however, the multiple range test indicated that meat from lambs of lot 3 was significantly (P<.05) more tender than that of lot 1. Statistical analysis of the shear data followed the trend of those for the taste panel, although the multiple range test indicated that the shear value for lot 3 was significantly (P<.05) lower than that for lot 4.

The average juiciness scores of the meat of the DES-implanted animals were 4.30, 4.24, 4.70, 4.24 and 4.44, for lots 1 through 5, respectively. Differences among these juiciness scores were not significant.

The data presented in figure 2 are somewhat divergent from those given in figure 1. It was demonstrated in figure 1 that both tenderness and juiciness were enhanced by increasing levels of dietary coumestrol. Figure 2 shows that tenderness improved in the DES-implanted lambs, when fed increasing amounts of coumestrol up to a level of 114 ppm. However, tenderness and juiciness were adversely affected in the meat of the DES-implanted lambs receiving a dietary intake of 132 and 151 ppm of coumestrol as compared to 114 ppm. Although there were no significant differences in the total moisture and fat contents of the loin muscles between the lots, it is apparent that some type of physiological interaction detrimental to the tenderness and juiciness attributes of the meat resulted when lambs were subjected to a combined treatment of DES implantation and a dietary coumestrol intake in excess of 114 ppm. Some indication of such effects was observed earlier by Johnston and Anglemier (1963), who reported a tendency of the serum alkaline phosphatase activity levels to be depressed in lambs implanted with DES and fed diets containing the higher levels of added coumestrol. The undesirable effect may be a reflection of overall estrogen level, since comparison of the data of the two figures, particularly those of lot 1, indicates that DES tends to promote tender-

![Diagram](image_url)
ness and juiciness of the meat from lambs receiving a low level (18 ppm) of dietary coumestrol.

Further investigations on the effects of high coumestrol diets appear to be justified particularly with less mature test animals. The effects of coumestrol on lighter weight and younger animals fed the experimental diets for a longer period cannot be ascertained from this study.

In view of increased interest in the organoleptic attributes of meat, it would seem desirable to investigate further the influence of a combination of high dietary levels of plant estrogens and synthetic estrogenic factors upon the meat quality of ruminants.

**Summary**

The effects of varying levels of dietary coumestrol in the presence and absence of DES implantation upon the organoleptic quality of lamb were studied. Tenderness and juiciness of lamb were enhanced by increasing levels of dietary coumestrol. Although meat from the DES-implanted lambs receiving a diet containing 114 ppm of coumestrol was rated juicy and the most tender, DES implantation combined with dietary coumestrol intakes of 132 or 151 ppm resulted in decreased tenderness and juiciness scores.

**Literature Cited**


