PREVENTION AND CURE OF MUSCULAR STIFFNESS
("STIFF-LAMB" DISEASE) IN LAMBS

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THE "stiff-lamb" disease or muscular stiffness is an ailment of young suckling lambs. Under field conditions the extent of the disease varies from year to year. It is most common in April or May while the ewes and lambs are in dry lot. It has been reported in many of the states where sheep are raised, and in several foreign countries.

It has been shown by Willman and associates (1930, 1931, 1934, 1940) that methods of management of the ewes such as the amount of exercise and the level of feeding, have little or no effect on the occurrence of the disease. In these investigations it was shown that the addition of vitamin C to the ration is not effective as a preventive. Experiments conducted during the last 15 years have thoroughly demonstrated that the feeding to the ewes of a ration of alfalfa and cull beans, or a ration of alfalfa, cull beans, oats and barley is followed by a high incidence of the disease in the lambs. It does not develop in lambs whose dams are fed mixed clover and timothy hay, corn silage and oats and wheat bran. The addition of wheat bran or wheat germ meal to the "stiff-lamb-producing" rations has been very effective in preventing the disease (table 1).

Post-mortem examinations show striking muscular lesions in many lambs. These appear to the naked eye as whitish areas in the muscle substance. Their extent varies, but they have been found at one time or another in nearly all of the skeletal muscles. A small proportion of the lambs shows heart lesions, which appear as white patches located under the endocardium, commonly in the right ventricle. Intra-muscular hemorrhages or edematous conditions have been found in some lambs. Extensive microscopic lesions have been found in the muscles of stiff lambs with no gross lesions. Normal lambs in the experimental groups have been free from the characteristic lesions. A more complete description of symptoms, pathological anatomy and histopathological changes was reported by Willman, Asdell and Olafson (1934).

It was recognized that the stiff-lamb disease has some points of similarity to the muscle dystrophy found by Madsen and co-workers (1935) in guinea pigs.

1 Acknowledgment is made to W. A. Hagan, Dean of the New York State Veterinary College and his associates, who have conducted the post-mortem examinations of lambs used in these trials and R. D. Crook, V. H. Melass and E. W. Klosterman, graduate assistants in Animal Husbandry, who helped with certain trials. Acknowledgment is also made to Professor L. A. Maynard and C. M. McClay of the Department of Animal Husbandry for their advice and assistance.
### TABLE 1. SUMMARY OF TREATMENTS AND NUMBER OF EWES USED IN STUDY OF "STIFF-LAMB" DISEASE, AND THE RESULTS OBTAINED

<table>
<thead>
<tr>
<th>Lambing season</th>
<th>Treatment</th>
<th>No. ewes</th>
<th>No. lambs being raised</th>
<th>No. of stiff lambs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1930 to 1939</td>
<td>Ewes fed mixed clover and timothy hay, corn silage and concentrate mixture of two parts oats and one part wheat bran, by weight</td>
<td>167</td>
<td>205</td>
<td>0</td>
</tr>
<tr>
<td>1930 to 1942</td>
<td>Ewes fed alfalfa hay and a concentrate mixture of three parts each of oats and barley and four parts cull beans, by weight</td>
<td>235</td>
<td>298</td>
<td>79</td>
</tr>
<tr>
<td>1934, 1935 and 1937</td>
<td>Ewes fed alfalfa hay and a concentrate mixture of five parts each of oats and barley, 50 parts wheat bran and 40 parts cull beans, by weight</td>
<td>50</td>
<td>68</td>
<td>4</td>
</tr>
<tr>
<td>1940, 1941 and 1942</td>
<td>Ewes fed alfalfa hay and a concentrate mixture of five parts each of oats and barley, 50 parts wheat germ meal and 40 parts cull beans, by weight. Lambs creep fed oats, barley and wheat germ meal</td>
<td>56</td>
<td>76</td>
<td>1</td>
</tr>
<tr>
<td>1943 and 1944</td>
<td>Ewes fed alfalfa hay and cull beans</td>
<td>52</td>
<td>65</td>
<td>49</td>
</tr>
<tr>
<td>1943</td>
<td>Ewes fed alfalfa hay, cull beans and wheat germ meal and lambs creep fed oats and wheat germ meal</td>
<td>29</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>1944</td>
<td>Ewes fed cull beans and alfalfa hay and both ewes and lambs fed mixed tocopherols</td>
<td>20</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>1944</td>
<td>Ewes fed cull beans and alfalfa hay and lambs fed alpha-tocopherol</td>
<td>24</td>
<td>21</td>
<td>0</td>
</tr>
</tbody>
</table>

pigs, rabbits, lambs and goats fed cod-liver oil. Morgulis and others (1936, 1938) reported that certain substances in the wheat germ and in some other feeds are essential for the maintenance of normal muscle tissue. Cary (1939) found that when rabbits are fed a cow ration consisting of a grain mixture, poor quality hay and small amounts of cod-liver oil, they eventually become paralyzed due to muscular dystrophy. He reported that synthetic alpha-tocopherol is effective in curing this paralysis. These findings and the excellent results obtained at the Cornell Station from feeding wheat bran and wheat germ meal (1940) indicate that the muscular dystrophy found in lambs may be due to a deficiency of vitamin E. The feeding of wheat germ meal has prevented the occurrence of the stiff-lamb disease in the flocks used in these experiments (see table 1) and also in a number of flocks of cooperating New York flock owners.
The Possible Role of Vitamin E

In order to test the value of wheat germ oil as a cure for the stiff-lamb disease, wheat germ oil was given as a drench to 7 stiff lambs in the spring of 1940. One of the lambs died and 6 lambs recovered. The following year wheat germ oil was given as a drench to 4 stiff lambs and wheat germ oil and glycine to 3 others. No treatment was given to a group of 4 stiff lambs. One lamb died and 2 recovered in the group treated with wheat germ oil and glycine. All recovered in the group given wheat germ oil and also in the group that was given no treatment. The results from these tests failed to show that these supplements as given had any curative value.

In 1942 mixed tocopherols were fed to the ewes for 10 weeks before lambing and to the ewes and lambs from lambing time in the spring until the flock was turned to pasture. For some unknown reason there were no stiff lambs in this lot or in the check lot fed a ration that had produced stiff lambs for 12 consecutive years.

An experiment (see table 1) was conducted in 1943-44 with 3 lots of 24 ewes each and their lambs to determine whether the disease would be prevented by feeding supplements of vitamin E with a ration that produced the disease. All the ewes in this experiment were fed a ration of cull beans (chiefly red kidney) and first and second-cutting alfalfa hay. Lot I received no other feed. The ewes in lot II also received for three months, beginning February 22, 1944 (24 days before the first lamb was born) 2 doses weekly of a 8.25 percent solution of mixed tocopherols in cottonseed oil at the rate of 9 ml. per dose. This vitamin supplement was fed on the beans. Two ml. of this solution were given as a drench at birth and once a week thereafter to each lamb in this lot (lot II). The ewes in lot III were given only beans and alfalfa, but their lambs were given as a drench 2 ml. of an olive oil solution containing 140 mg. of d, l-alpha-tocopherol acetate. This is 6 or 7 times the requirement of rabbits as reported by Eppstein and Morgulis (1941).

On May 22 there were 20 lambs in lot II and 21 lambs in lot III. No stiff lambs were produced in these lots while 13 lambs became stiff out of 27 raised by the ewes in lot I which had been fed no vitamin E supplements.

Alternate lambs of those in lot I with definite symptoms of the disease were treated with a water-soluble disodium salt of d, l-alpha-tocopherol phosphoric acid ester. One hundred mg. of this material dissolved in about 5 ml. of sterile water were injected subcutaneously. Four lambs were given only one dose each and 3 were given a second dose after an interval of 3 to 8 days. Six of the 7 lambs treated made rapid recovery, the symptoms dis-

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1 The mixed tocopherols were supplied by Distillation Products, Incorporated, Rochester, New York, and the alpha-tocopherol compounds by Hoffman-LaRoche, Incorporated, Nutley, New Jersey.
appearing in 7 to 19 days following the first treatment. One stiff lamb showed marked symptoms when he was 26 days old. He died 8 days later although treatment had been given when he was 26 and 29 days old. The autopsy revealed pneumonia, and gross lesions of muscular dystrophy in the skeletal muscles. Five lambs died in the group of six untreated stiff lambs and the characteristic lesions were found. The lamb in this group that recovered never showed marked symptoms.

The vitamin E content of the rations fed in these experiments has not been determined. Hathaway and Davis (1934) have reported that twenty to twenty-five percent of alfalfa furnished enough vitamin E to allow rats to cast litters. The ewes included in the experiments reported here have produced lambs that seemed normal at birth and made satisfactory gains before they exhibited symptoms of muscular stiffness. It is possible, however, that there is not enough vitamin E in the diet of the suckling lambs to prevent the occurrence of the disease. Vitamin E may not be the only factor involved in this disease. Further studies are in progress.

**Summary**

The results of the experiments reported here indicate that the lack of vitamin E in the ration of the lambs may be the cause of the stiff-lamb disease. In the trials conducted in 1933-44 the disease was prevented by feeding an oil solution of mixed tocopherols to the ewes and to the lambs or by feeding an oil solution of d, l-alpha-tocopherol acetate to the lambs after birth. Six of 7 stiff lambs recovered following the subcutaneous injection of a water solution of the disodium salt of d, l-alpha-tocopherol phosphoric acid ester, while 5 of 6 untreated stiff lambs died.

Earlier work showed that the number of stiff lambs was reduced markedly when liberal quantities of wheat bran were substituted for part of the oats and barley in a ration which also included cull beans and alfalfa hay. The inclusion of liberal amounts of wheat germ meal in the rations fed to the ewes and its use in the creep feed almost entirely prevented the disease from occurring.

**Literature Cited**


