

lethal doses of infested meat.² All rats showed severe symptoms and died before the seventh day of the experiment.

In all the infested rats that survived the infestation, there was a marked increase in eosinophiles and a rapid rise in neutrophiles during the intestinal stage of the parasites.

Our observations record that the only protection given to rats for a limited period of time against infestations of *Trichinella spiralis* was the feeding of small and gradually increased doses of trichinous meat.³ Attempts to protect rats by feeding anti- and convalescent serums, trichina powder, and by injecting intraperitoneally Coca's suspension of the dried and finely ground larvae failed to give any protection.

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Plant Extracts in the Nutrition of Guinea Pigs and Rabbits.*

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It has been known for years¹ that rabbits develop paralysis and soon die when they are restricted to rations of the concentrates commonly employed in livestock feeding. If, however, these rations are supplemented with good quality forage such as alfalfa hay they become entirely adequate. Our first basal ration, No. 800, simulated in composition a similar ration which contains 10% of alfalfa meal, and which had proved adequate for growth. It has the following composition:

Ground oats.....	53.1	Casein	0.25
Whole milk powder.....	34.2	Corn starch.....	0.43
Cod liver oil.....	1.8	Lard	0.04
Sodium chloride.....	0.9	Cellulose	0.14
Salts.....			0.14

A long series of feedstuffs other than forages was studied in an

² Lucker, J. T., *J. Parasit.*, 1932, **19**, 243.

³ Ducas, R., 1921, *L'Immunité dans La Trichinose*. Thèse, Paris (Jouve et Cie), Pp. 47.

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¹ Hogan A. G., and Ritchie, W. S., *Mo. Agr. Exp. Sta. Res. Bul.*, 1934, No. 219.

effort to find a soluble supplement that would make Ration 800 adequate for growth, but the only ones that offered any promise were some of the vegetable oils. The first successful ration employed, No. 2003, was made up of Ration 800 90 parts, and corn oil (Mazola) 10 parts. The data summarized in Table I indicate that this ration makes a close approach to complete adequacy during the growing period, but it was not entirely satisfactory.

TABLE I.
History of Rabbits That Received Ration 2003 Containing Corn Oil.

Date	Rabbit No.				
	♀ 426 gm.	♀ 430 gm.	♂ 433 gm.	♂ 443 gm.	♂ 447 gm.
7-20-34	470	480			
11-20	2890	2640			
12-20	litter ¹				
1-1		3170 ²			
1-15-35	3220		445	490	480
3-5			1290	1210	1330
3-19			1730	1590	1050
3-26	3510 ²		1680	1800	1160
3-28			dead ³		
4-11					dead ⁴
5-14				2550 ²	

¹Litter of 5, dead at birth.

²Ration changed.

³Pneumonia.

⁴Coccidiosis.

Madsen² reports that cottonseed oil confers partial protection from muscular dystrophy in guinea pigs and rabbits. Goettsch and Pappenheimer³ observed that corn oil, cottonseed oil, peanut oil, and soy bean oil are all effective in preventing nutritional encephalomalacia in chicks. In addition to corn oil we have also tried soy bean oil, but in our experience wheat germ oil is by far the most potent. Even advanced cases of muscular dystrophy are healed by including it in the ration. The basal diet finally chosen is made up as follows: Ground oats 60, skimmilk powder 33, wheat germ oil 4, cod liver oil 1, NaCl 1, CaCO₃ 1. This ration invariably supports a rapid rate of growth, but it is grossly inadequate during the reproductive stage. Guinea pigs had very irregular oestrus cycles, few became pregnant, and some of these aborted. Only one litter was reared and it grew very slowly before weaning. The rabbits were less susceptible to these disturbances. In all 44 litters were obtained from females on various modifications of the basal diets,

² Madsen, L. L., *J. Nutr.*, 1936, **11**, 471.

³ Goettsch, Marianne, and Pappenheimer, A. M., *J. Biol. Chem.*, 1936, **114**, 673.

but few survived. Seven litters of 2 each, and 4 litters of one each were reared. Post mortem examination of the young revealed two types of abnormalities, either of which would be sufficient explanation of the mortalities. In many cases there was liver damage, ranging from slight to severe. In extreme cases this organ was greatly enlarged, fatty, and gray in color. The most striking lesion, however, was extensive hemorrhage, which may occur in one or more sites such as the stomach, intestines, muscles, peritoneal cavity, or in the subcutaneous region. Many of the young that survived had recovered from obvious subcutaneous hemorrhages.

At this stage no supplement studied, except some form of forage, had offered any promise so we turned to a plant extract that had proved effective in somewhat similar abnormalities with suckling pigs (Mo. circ. 187, 1935). Young, vigorously growing barley was finely macerated, the juice expressed as completely as possible, and this was offered, instead of water, to a guinea pig. The remainder of the ration, No. 2178, was of the simplified type similar to that described in a previous publication. This animal reared a litter of 2 vigorous, rapidly growing young. Additional data appear in Table II. Subsequently similar extracts were concentrated *in vacuo* and incorporated in the ration at levels of 5 and 10%. The 5% level was obviously inadequate for guinea pigs as none of them produced young. One litter was reared on the 10% level, but additional observations are required for a satisfactory evaluation of the ration. One rabbit litter on each level was reared, but the minimum amount necessary to make the ration complete was not determined.

An effort was then made to obtain active fractions from forages. However, these studies have been retarded by the high summer temperatures, for it is impossible to distinguish between the failures that are due to unfavorable temperatures and those that are due to inadequate rations. The preparations that have given most promise up to the present are a dilute alcohol extract of the juice of young cereal grasses, oats or barley, and an ethyl ether extract of dehydrated alfalfa. Since guinea pigs and rabbits respond somewhat differently to the experimental diets they will be described separately.

With the alcohol extract alone advanced pregnancy in the guinea pigs was rarely observed and there was some evidence of early abortion. When normal litters were cast the mortality was low but growth was subnormal. With the ether extract alone the guinea pigs had regular oestrus cycles and became pregnant, but the ration was still inadequate, as of 5 females 3 died after giving birth to litters. Of the other 2, one gave birth to an apparently normal

young, but it was dead when found. The other female delivered 2 normal young but they grew slowly and only one survived. The ether extract seemed especially essential during pregnancy, and the alcohol extract seemed essential during lactation. Either fraction improved the basal diet, but in the amounts tested neither has been satisfactory by itself.

Insufficient data are available now to show whether or not the dilute alcohol extract improved the ration for rabbits in any significant way. When this preparation was included rabbits gave birth to the normal number of young, and of litters, but few were reared. Many were hemorrhagic and dead at birth. Practically all of those alive developed hemorrhages during the suckling stage and died. This condition has been observed repeatedly, and there is no doubt that it can be reproduced consistently. With the ether extract alone the rabbits delivered their young as usual, but as shown in Table II they were not very successful in rearing them. The point to be emphasized is, the ether extract is completely effective in preventing hemorrhages.

Combinations of the two extracts have been much more effective than either one alone. On rations that contained 2% of the alcohol extract and 1% of the ether extract, 2 guinea pigs and 3 rabbits have reared litters, though it may be that these rations do not provide optimum nutritional conditions.

Our observations on forage extracts are summarized in Table II. The supplements used are as follows:

1. Plant juice, *ad lib.*
2. Concentrated plant juice, dry matter 5% of ration.
3. Same as 2, dry matter 10% of ration.
4. Ether extract of dehydrated alfalfa, 1% of ration.
5. Plant juice soluble in 25% alcohol, dry matter 2% of ration.
6. Dilute alcohol extract of dehydrated alfalfa, 2% of ration.