Caecotrophy In Rabbits

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Caecotrophy, commonly known as coprophagy, is a specialized digestive strategy common in the Mammalian order Lagomorpha (rabbits, hares and pikas) and some species of rodents. Caecotrophy plays a central role in digestive physiology and consequently well-defined rhythmical patterns of feeding and excretion have been shown to occur. It is the ingestion of specially produced soft faecal pellets, which are usually produced at night in the domestic rabbit. It is similar to the chewing of cud in cattle, and is sometimes referred to as “pseudo-rumination”. However, the two processes are very different. The rabbit is much less efficient at digesting fibre. Microbial activity in the ruminant affects the food before it reaches the main regions of digestion and absorption, but microbial activity in the rabbit takes place on the undigested residues of food. In order to understand caecotrophy, a review of the rabbit’s digestive system is required.

Digestive System

The rabbit’s digestive system is well designed for the digestion of the large quantity of forage typical in its herbivorous diet. The digestive system occupies a large proportion of the body cavity and is fully developed in the nine-week-old rabbit (Figure 1). Approximately 88% of the digesta (digestible material in the digestive system) is contained in the stomach and caecum. The caecum, the largest organ of the digestive system, has a capacity ten times that of the stomach, and comprises approximately 40% of the gastrointestinal tract. Digestion begins in the mouth (oral cavity - 1), where the teeth and saliva begin the preliminary breakdown of the food consumed. The food travels down the oesophagus (2) and into the stomach (3). The food remains in the acidic stomach for three to six hours, undergoing little chemical change. The gastric contents are slowly released into the small intestine (4) where further digestion occurs. Bile and pancreatic enzymes released into the small intestine break down protein and fat into particles small enough for absorption. Indigestible fibre is pushed into the colon (large intestine - 7) where it is formed into hard faeces. The ingesta, the remaining digestible material, move into the caecum (6) where microflora (anaerobic bacteria) ferment the digesta and more absorption occurs. The fermented digesta is expelled into the colon and formed into soft pellets, known as caecotrophes.

Figure 1. The digestive tract of the rabbit.
Production of Two Types of Faeces

Caecotrophy begins around the age of three weeks in the domestic rabbit, when they start to consume solid feed in addition to their mother’s milk. Soft faeces production in the post-weaned rabbit increases linearly with age, and peaks at 63 to 77 days of age. This period corresponds to the maximum growth requirements and to the greatest increment in feed intake.

The functioning of the rabbit’s digestive system is the same as that of other monogastrics (one-stomached animals). The distinctiveness lies in the dual function of the proximal colon. Muscular contractions of the colon divert fine, non-fibrous particles into the caecum and only pass non-fibrous particles larger than 3 mm, which are formed into hard faeces. The material sent to the caecum is subjected to several hours of microbial fermentation. High levels of volatile fatty acids (VFA), end products of fermentation, are absorbed into the bloodstream. VFA provide a major energy source for the rabbit, and their production is dependent on the composition of the caecal microflora and the type and availability of the feed ingested.

During the early morning hours the remaining caecal contents entering the colon are formed into small 5mm pellets by the colon wall contractions. The pellets are composed of digesta that has been exposed to bacterial digestion, as well as considerable quantities of bacteria, all from the caecum. The colon wall secretes a mucous layer over the pellets, which protects the pellets from the stomach acids following ingestion where they are stored for several hours. These small dark pellets form clusters known as caecotrophes (Figure 2).

![Figure 2. Caecotrophes and hard faeces of the rabbit. The caecotrophes can be differentiated from the hard faeces by their shiny appearance, small size and clustering.](image)

Caecotrophy seems to occur in a distinct rhythmical pattern. Commercial rabbits tend to produce the majority of hard faeces during the day with peaks coinciding with feeding times. The production and ingestion of soft faeces occurs at night, regularly occurring approximately four hours after the last meal. Since wild rabbits are nocturnal, caecotrophy occurs during the day.

Once the caecotrophes are formed they are removed directly from the anus and swallowed whole. They will lie in a mass in the stomach for 6 – 8 hours and then are broken down and go through the usual digestive processes. Rabbits will ingest 50 to 80% of their total fecal material on a daily basis. Factors such as age, quantity and nutritional quality of feed
ingested will affect the amount of fecal matter consumed. Some fractions of the rabbit’s diet will be recycled through caecotrophy as much as four times, and thus the rabbit’s digestive process can take from 18 to 30 hours in total.

But how does a rabbit recognize caecotrophes? A neural response (Jenkins, 1999) or the strong odour of VFA (Stevens and Hume, 1995) could stimulate caecotrophe consumption directly from the anus. Germ-free rabbits do not perform caecotrophy (Yoshida et al, 1968), which suggests that bacteria may be the attractant. Healthy rabbits will consume all soft feces, whereas an ill rabbit may leave large quantities among the rest of its excreta.

The Benefits of Caecotrophy

Caecotrophy in small herbivorous mammals is considered an adaptation to the metabolic disadvantage of small body size, especially when feeding on low quality diets. The rapid metabolic rate of small herbivores requires that energy has to be extracted rapidly and food should not be retained in the gastrointestinal tract for long periods. When a small mammal ingests food rich in plant cell wall material (indigestible fibre), it is retained in the digestive tract for a long period of time. No fresh food can be consumed because of the lack of storage volume in the digestive tract, and as a result the animal starves to death, although its digestive tract is full (Langer, 2002). Through caecotrophy small mammals are able to ingest a “home-made” food rich in microbial products, such as protein and vitamins.

The consumption of caecotrophes is influenced by dietary protein and energy. When an animal is fed a low energy diet, caecotrophy ingestion is maximized (Jenkins, 1999). Caecotrophe consumption increases with lower levels of dietary protein fed to rabbits, and high levels of protein decrease consumption (Cheeke, 1994).

Caecotrophes are much higher in moisture than the regular hard faeces, and are often referred to as soft faeces (Table 1). The composition of caecotrophes and the quantity expelled daily are independent of the type of feed consumed, since the bacteria remain constant. The amount of dry matter recycled daily through caecotrophy remains relatively constant and is independent on the fibre content of the feed.

Table 1. Nutrient composition of hard and soft faeces of rabbits: range for ten different feeds (balanced concentrate feeds, green and dry forages) (Proto, 1980).

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Hard Faeces</th>
<th>Soft Faeces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>34 - 52</td>
<td>63 - 82</td>
</tr>
<tr>
<td>Dry Matter</td>
<td>48 - 66</td>
<td>18 - 37</td>
</tr>
<tr>
<td>Percent Dry Matter Basis (DMB %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>19 - 25</td>
<td>21 - 37</td>
</tr>
<tr>
<td>Crude Fibre</td>
<td>22 - 54</td>
<td>14 - 33</td>
</tr>
<tr>
<td>Fat</td>
<td>1 - 3</td>
<td>1 - 5</td>
</tr>
<tr>
<td>Minerals</td>
<td>3 - 14</td>
<td>6 - 11</td>
</tr>
<tr>
<td>Nitrogen-Free Extract</td>
<td>28 - 49</td>
<td>29 - 43</td>
</tr>
</tbody>
</table>
Caecotrophy allows the absorption of essential amino acids (especially lysine, sulfur amino acids and threonine), volatile fatty acids, vitamins B and K. Caecotrophy increases the protein digestibility of forages in rabbits. Rabbits are able to digest 75 to 80% of alfalfa protein versus 50% when rabbits are denied access to caecotrophes (Cheeke, 1994). Long term lack of caecotrophes results in malnutrition and deficiency of B vitamins, such as thiamine. A study performed by Phiny and Kaensombath (2006) concluded that the growth rate of young rabbits was reduced by 50% when they were denied access to caecotrophes (Figure 3). Feed conversion was also reduced in comparison to rabbits given access to caecotrophes.

![Graph showing the effect of access to caecotrophes on rabbit growth rate](image)

**Figure 3.** Effect of access or no access to caecotrophes on the growth rate of rabbits fed water spinach with or without supplementation with rice bran.

Dietary fibre has an important role in maintaining gut health, stimulating appetite, gut motility and caecotrophy, reducing fur chewing, and preventing enteritis. Rabbits need 20 to 25% dietary fibre to maintain gut health. The higher the crude fibre content of the diet and the coarser the food particles, the quicker it passes through the digestive tract. The high feed intake (65 to 80 g/kg body weight) and rapid feed transit time (19 hours) enable the rabbit to consume lower quality forages and still meet their nutritional requirements. Highly digestible diets (high starch content) that contain relatively little roughage are often incompletely digested in the rabbit’s small intestine due to the rapid transit time. Incomplete digestion of the diet results in the availability of starch for microbial fermentation (Stevens and Hume, 1995). Excess starch in the caecum results in extremely rapid growth of microbes. This increases the risk of undesirable bacteria, such as *Clostridium spiroforme*, populating in the digestive tract, which can result in enteritis, diarrhea and possible death.

Caecotrophy is a vital process for herbivorous mammals with a rapid metabolic rate and small body size. It allows the rabbit to consume poor quality, high fibre diets and obtain necessary nutrients, such as essential amino acids and vitamins.

**References:**


