



# Variations in starch digestibility in non-ruminants<sup>☆</sup>

Julian Wiseman\*

*Division of Agricultural and Environmental Sciences, University of Nottingham, School of Biosciences,  
Sutton Bonington Campus, Loughborough, LEICS LE12 5RD, UK*

## Abstract

Starch is the major energy-yielding ingredient in diets for both pigs and poultry, and its effective digestion will have a major impact on their energy balance; a common presumption is that it is completely digested but, whilst this may well be the case over the entire digestive tract (through excreta and faecal analyses), this is rarely found within the small intestine. Starch disappearance from the large intestine is through microbial fermentation whose products, volatile fatty acids, are not used with the same efficiency of metabolic utilisation in energy-yielding pathways as is glucose (the product of amylolysis in the small intestine). Other consequences of incomplete starch digestion in the small intestine may include excessive large intestinal fermentation leading to diarrhoea and dehydration.

Variations in small *versus* large intestinal digestibility for starch have not received attention but it should be in future assessments. Starch from peas is digested less well in the small intestine than from cereals. Separation of starch into different categories (rapidly digested, slowly digested and resistant to digestion) could be a useful development.

There is some debate as to whether there is amylase adequacy in the newly hatched chick/post-weaned piglet. However although the activity of  $\alpha$ -amylase may well increase beyond these ages, it is still generally believed that poor digestibility values of starch in young broilers cannot be attributed to inadequate levels of  $\alpha$ -amylase and is more likely to be attributable to extrinsic and/or intrinsic factors. With respect to piglets, there appears to be a link between feed intake and enzyme activity; thus reduced intake (common in the immediate post-weaning period) may be responsible for limited amylase secretion rather than a capacity for amylase synthesis.

There have been numerous studies evaluating the digestibility of starch from wheat in poultry; isolated wheat starch was readily digested *in vitro* by chick pancreatic  $\alpha$ -amylase, even that from wheat with relatively low apparent metabolizable energy (AME) values. Variations in starch digestibility

<sup>☆</sup> This paper is part of the special issue “Starch structure and digestibility: Basic aspects and new research”, Guest Edited by Birger Svihus and Ole Taugbol.

\* Tel.: +44 1159516054; fax: +44 1159516099.

have, nevertheless, been recorded. Thus, it is not starch *per se* that is poorly utilised in some samples but other factors within wheat may be reducing starch digestibility. The starch/protein interface in the endosperm of wheat (responsible for the ‘hard’ and ‘soft’ endosperm texture) might be responsible for problems with starch utilisation, but no firm evidence exists for this.

A key recent development has been the emergence of near-isogenic lines which are very similar except for key characteristics. Thus, lines near-isogenic except for hardness have been used to establish that hard wheats are less well digested in poultry than soft ones. Similarly, wheats containing the IBIR rye translocation are less well digested. Such developments have been crucial as the independent effects of hardness and IBIR cannot be established conclusively if there are other unknown factors present. Thus, random variety trials are of no value in investigations of what influences starch digestion. It is possible that the negative effects of the IBIR translocation may be offset by the positive effects of soft endosperm although it is crucial to point out that endosperm texture is a continuum between very hard and very soft, not simply hard and soft.

There have been many attempts to assess starch digestibility *in vitro* as a means of screening samples. Certainly there has been success in terms of linking *in vivo* digestibility to rate of *in vitro* digestibility. However it has been suggested that slowly digested starch will lead to better performance than rapidly digested starch.

© 2006 Elsevier B.V. All rights reserved.

*Keywords:* Starch; Digestibility; Non-ruminants; Region of digestive tract; Cereals; Wheat; Peas; *In vitro* assessment; Plant breeding

---

## 1. Introduction

Starch is the major energy-yielding component of diets for pigs and poultry and is presumed to be almost completely digestible in both species at all ages. As an example, the European equation for the prediction of apparent metabolisable energy (AME) value of compound poultry diets has a fixed coefficient for starch content. However, data are now emerging which demonstrate clearly that this assumption should be challenged, even within samples of the same plant species. Furthermore, detailed investigations into the region of the digestive tract where starch is digested (and the degree of digestion) are important in the context of the energy-yielding potential of starch. Other papers in this volume will consider starch structure and processing. The current paper will discuss variability in the digestibility of native (*i.e.* raw) starch within commonly utilised raw materials for pigs and poultry. It should be borne in mind that native starch is essentially crystalline (although to a varying degree depending on source) and that crystals are less well digested than amorphous starch rendered such by, for example, heat treatment which will, interestingly, denature  $\alpha$ -amylase inhibitors and  $\alpha$ -amylase itself (both are potential components of cereals), although this topic is outside the scope of the current paper.

## 2. Amylase adequacy

It is important to consider whether variations in starch digestibility are attributable to changes in concentrations/activities of endogenous  $\alpha$ -amylase.

Download English Version:

<https://daneshyari.com/en/article/2421161>

Download Persian Version:

<https://daneshyari.com/article/2421161>

[Daneshyari.com](https://daneshyari.com)