Spatiotemporal Mapping of the Motility of the *ex vivo* Rabbit Caecum.

A thesis presented in partial fulfilment of the requirements for the degree of Masters of Physiology in Digestive Biomechanics (Physical Process of Digestion)

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Abstract

This work sought to determine the contractile factors influencing the coordination of inflow and out flow from the caecum, and the mixing and mass transfer within. Specifically, the work was focussed on the ileocaecal junction in the domestic rabbit (*Oryctolagus cuniculus*). The salient questions to answer were;

1. What are the contractile movements in the body of the caecum and associated structures of the rabbit caecum?
2. How are contractile movements coordinated at the body of the rabbit caecum and how does this affect the pattern of motility?

The following two main experimental works of this thesis were all conducted using live gut rabbit caecum preparations maintained *ex vivo*. Spatiotemporal mapping and electromyography was used to visualize and quantify contractile activity and coordination in the caecum.

1. High definition radial, strain rate and intensity spatiotemporal mapping was used to quantify contractile movements of the body and associated structures of the rabbit caecum.
2. Coordination between contractile events at different sites in the basal portion of the rabbit caecum and its associated structures were identified by electrophysiological recordings with simultaneous one dimensional, and a novel two dimensional, spatiotemporal mapping technique.

The following are the main findings and implications of the work.

1. The body of the caecum exhibited two patterns of motility that appeared autonomous, i.e. occurred independently of any contractile activity at the inlet or outlet. Firstly, a pattern termed **ladder activity** consisted of orderly sequential contractions in the spiral turns in the *corpus ceci*. Secondly, less localised, rapidly propagating synchronous contractions that were termed **mass peristalsis**.
2. Movements of the ileum and *sacculus rotundus* occurred at the same frequency and were broadly coordinated. Further, the findings suggest that the action of the *sacculus rotundus* may result from its distension with chyme by ileal peristalsis and

that the subsequent propagation of contraction along the basal wall of the caecum toward the colon may be augmented by this local distension.

3. The caecum and proximal colon/ampulla coli act reflexly to augment colonic outflow. When the caecum is distended and mass peristalsis is instituted, the action of the latter overrides the inherent rhythm and direction of haustral propagation in the adjacent portion of the proximal colon but not in the terminal ileum.

In conclusion, coordination, mixing and mass transfer in the rabbit caecum is a very complex, dynamic and largely autonomous process. Further, spatiotemporal mapping techniques enabled the identification and visualization of previously unknown contractile movements within the rabbit caecum.

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Preface

This thesis is written according to the regulations stipulated in the latest version of the **'Guidelines for the Preparation and Submission of Thesis'**, published by Massey University.

All animal works were carried out in strict accordance with the 'New Zealand Code of Practice for the Care and Use of Animals for Scientific Purposes'. The procedures carried in this thesis were also approved by the Massey University Animal Ethics Committee (MUAEC approval no. 08/75 and 12/01).

The thesis format complies with the format of a thesis based on publications, as described on page 63-64 under the section 'Submission of a thesis based on publications'. The journal article has been reproduced in this thesis in its entirety at the relevant chapters. Below, details of the journal article that has been published and the chapter of which it may be found are listed and where it appears in my thesis.

Chapter 3:

Hulls C, Lentle RG, De Loubens C, Janssen PWM, Chambers P, Stafford K (2012) Spatiotemporal mapping of *ex vivo* motility in the caecum of the rabbit.

Published in- Journal of Comparative Physiology B 2012 Feb; 182(2):287-97. DOI: 10.1007/s00360-011-0610-2.

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