In our previous paper, we reported different properties between isometric and isotonic contractions induced by the high concentration of potassium in guinea-pig taenia coli (1). In other current studies, Golenhofen and his co-workers have for the past ten years investigated spontaneous contractions in visceral smooth muscles including the taenia (2, 3, 4). As precise comparisons between isometric and isotonic spontaneous contractions have, however, not yet been made, such was attempted herein on the taenia coli.

An alternative recording of isometric and isotonic activities of a same muscle was

![Diagram](Fig. 1. Apparatus for recording isometric and isotonic activities of the same muscle preparation alternatively.)
made (Fig. 1). Isometric and isotonic transducers (Nihon Kohden) were held with a universal stand in a vertical direction above an organ bath. The three elements of this system, the organ bath, isometric and isotonic transducers were arranged lineally. The muscle preparation was first attached to the isotonic transducer. The isotonic load was 0.2 g. On the other hand, we employed 0.6 g for the basic isometric tension, this tension being the standard in our laboratory. Since the isotonic load was smaller than the basic isometric tension, we could connect the isometric transducer to the muscle via the isotonic one. Thus in this state was the isometric muscle activity recorded. After the isotonic activity had been recorded, the connecting thread between the two transducers was removed.

Strips of taenia coli were isolated from male Hartley strain guinea-pig weighing 300-700 g. The isolated muscle was suspended in the organ bath containing 10 ml of a modified Tyrode solution equilibrated with 95% O₂ and 5% CO₂, pH about 7.2 at 37°C. The solution contained NaCl 136.8, KCl 2.7, CaCl₂ 2.5, MgCl₂ 1.0, NaHCO₃ 11.9 and glucose 5 (mM).

In the isometric measurement, periodic spontaneous contractions occurred rhythmically (Fig. 2-A). The period was 5-12 min which was regarded as the minute rhythm.

![Fig. 2. Isometric and isotonic spontaneous contractions recorded in a same strip of guinea-pig taenia coli. A : isometric ; B, C, D, E and F : isotonic. The isotonic loads were 0.2, 1, 2.5 and 5 g in B, C, D and E respectively. At the final part of E, the load was returned to 0.2 g. The returned activity was recorded in F. Time of initiation of the first contraction is expressed as 0 min in A.](image-url)
described by Golenhofen and Loh (3). Golenhofen classified the spontaneous fluctuations of the tissue into three; the second rhythm, the basic organ-specific rhythm and the minute rhythm in which the frequencies of the rhythms were 40–70, 5–10 and 0.2–2/min respectively. The first rhythm was of electrical spike discharge and the latter two were of the mechanical activities (4). They maintained that there was no basic organ-specific rhythm in the taenia (3, 4). However, in our work, a 5 sec rhythm which resembled the basic organ-specific rhythm was detected when the isotonic measurement was carried out with a very small load, 0.2 g (Fig. 2-B and F).

When the small load, 0.2 g was exchanged for heavier ones, 1, 2.5 and 5 g in that order, the 5 sec rhythm faded and the minute rhythm appeared in the 1 g or above loaded isotonic state (Fig. 2-C, D and E). Golenhofen and Loh also carried out isotonic measurements, however, they employed 2–3 g or over for isotonic loads and not 0.2 g. Thus the period of the rhythm in their experiment resulted in the minute order (3).

In our experiments, when the isotonic load was increased, the isotonic state approached to the isometric. This relation was suggested by our previous study in which the comparison between isometric and isotonic contractions induced by hypertonic 40 mM KCl was made (1).

In Fig. 2, all rhythms continued during the experimental period. However, some preparations showed a disorder in continuity of rhythm. Therefore, the spontaneous contractions seem to be further controlled by unavailable factors, e.g. synchronization, metabolism, etc.

Our present data of the period of the minute rhythm is therefore not consistent with that of Golenhofen’s. The discrepancy may be due to the differences in the solution, bath temperature, etc.

A simple method of alternative recording of isometric and isotonic activities in a same muscle has thus been developed. Using this apparatus, the 5 sec rhythm of spontaneous contraction was found in guinea-pig taenia coli and was detectable in the small loaded isotonic measurements. The minute order rhythm appeared typically in the isometric and was also observed when the load was increased in the isotonic. Control can indeed be maintained over the mechanical rhythms of the 5 second- and minute-order in a strip of smooth muscle.

REFERENCES