

## CALCIUM AND THE EFFECTS OF DRUGS ON SMOOTH MUSCLES OF THE OESOPHAGUS OF *APLYSIA BRASILIANA* (MOLLUSC-OPISTOBRANCH)

Paulo Sawaya and Winston M. Leahy  
(Dept. Fisiologia Geral — Instituto de Biociências e  
Instituto de Biologia Marinha — Universidade de  
São Paulo. Caixa Postal 1130, Z C 9 S. Paulo,  
Brasil)

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EFEITOS DO CALCIO E DE DROGAS SÔBRE A MUSCULATURA LISA DO ESÔFAGO DE *APLYSIA BRASILIANA* (MOLUSCO-OPISTOBRÂNQUIO).

**RESUMO** — Movimentos espontâneos do esôfago de *Aplysia brasiliana* apresentam dois tipos de contração: tônicas ou sustentadas e fásicas. Ambos os tipos são afetados pelo teor de  $\text{Ca}^{++}$  na água do mar. Ação da ACh sobre a musculatura do esôfago deste Gastrópode — Opistobrânquio também depende diretamente do teor de  $\text{Ca}^{++}$  no líquido perfusor que é da ordem de 0.020 g/l. As reações do órgão a diferentes salinidades foram estudadas e discutidas.

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**ABSTRACT** — Two types of contractions of the oesophagus of *A. brasiliana* have been described: tonic or sustained and phasic. Both types are affected by the amount of  $\text{Ca}^{++}$  in the sea water. The influence of ACh on the oesophagus of this Gastropod — Opistobranch also depends directly upon the amount of  $\text{Ca}^{++}$  (0.020g/l) in the perfusion fluid. Reactions of the organ to different salinities were also studied and discussed.

1.

### Introduction

It was shown in previous papers (Sawaya & Cipolli, 1969 p. 7) that Acetylcholine provokes a sustained contraction on the muscle fibers of the oesophagus of *Aplysia brasiliana*, but does not abolish the spontaneous movements. These movements were indicated as phasic contractions because they are rapid and not affected by ACh.

Besides  $\text{Ca}^{++}$  ions it was demonstrated also that Atropin blocks the effects of ACh. The organ is also sensitive to Serotonine (5—Hydroxytryptamine).

In this paper the results of some experiments will be discussed on the effect of lacking of  $\text{Ca}^{++}$  and the variation of salinity in two types of the tonic and phasic contractions of the oesophagus of *Aplysia brasiliana*.

2.

### Material and Methods

The material used was the same mentioned in the previous paper by Sawaya and Cipolli (1. c.).

The perfusion fluid was balanced in its ionic content, according to the amount of salts of sea water of the same place where the molluscs were caught. The following artificial sea water was prepared: NaCl-21, 49g.; KCl-0, 745g.;  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ -1, 472.; Mg  $\text{Cl}_2$ -6,652g.;  $\text{Na}_2\text{SO}_4$ -5,03g.; NaBr-0,634g.;  $\text{NaHCO}_3$ —1,278g.

After some preliminary experiments, attention has been called to the different behaviour of two halves of oesophagus, and to clarify this point the organs were cut into two parts, each one used separately in the perfusion bath. For recording isometric and isotonic contractions a Shie'd type lever has been adjusted to the kymograph. All experiments were done at room temperature between 20° and 24°C.

3.

### Experiments

Some experiments have been done in order to study the influence of ions  $\text{Ca}^{++}$  on the oesophagus of *Aplysia brasiliana*. It was demonstrated that, when in the perfusion fluid  $\text{Ca}^{++}$  is omitted there is strong decrease of the contraction when muscle was stimulated by ACh. It seems that lacking of  $\text{Ca}^{++}$  would induce an increasing of  $\text{K}^+$  which depolarizes the muscle membrane. In such

a condition when the preparation is perfused again with artificial sea water, the contractions return to normal condition.

It was shown also that the expontaneous contractions depend on the amount of  $Ca^{++}$  in the sea water. The experiments performed gave the following results: without calcium no expontaneous contractions; with 10% and 20% of  $CaCl_2$ , that is, 0.040g. and 0.070g. of  $Ca^{++}$  expontaneous contractions of the organ does not appear, but if the perfusing fluid contains more than 30% of  $CaCl_2$  which corresponds to 0.12g of  $Ca^{++}$ , those contractions start again. Recovering of the preparation arrive only if the perfusing fluid contains 80% of  $Ca^{++}$  that is 0.32g. of  $Ca^{++}$ . Normal filtered sea water has 1,472g. of  $CaCl_2$ . (Fig. 1).

The smooth muscle of the oesophagus of *Aplysia brasiliiana* is also sensitive to  $0.025\mu g$  ACh. It has been demonstrated (Sawaya & Cipolli 1969, p. 16) that a typical sustained contraction occurs in this condition but decreasing of  $Ca^{++}$  from 90% to 0% determine reduction of the intensity of sustained contractions until the amount of  $Ca^{++}$  is reduced to 90% or 0.040 of ACh is no more effective (fig. 2).

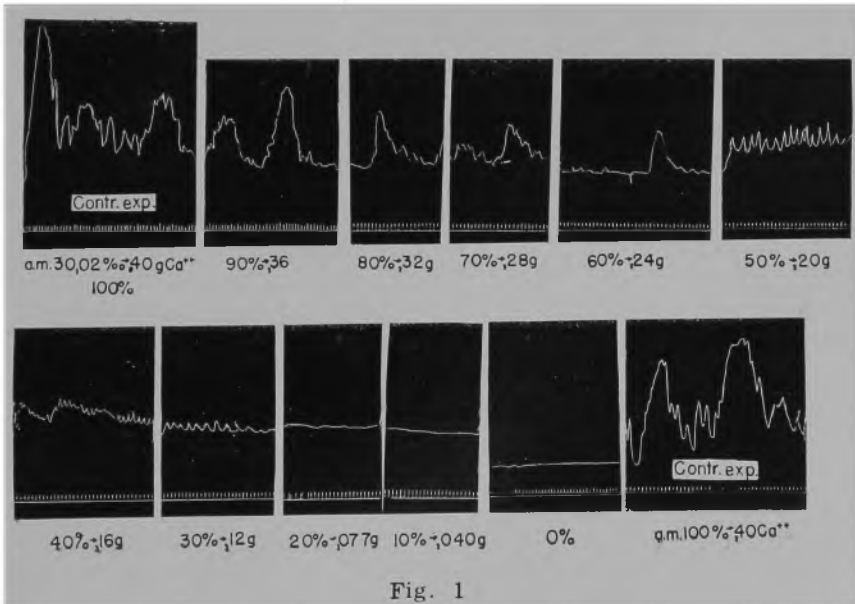


Fig. 1

*Aplysia brasiliiana*, Effect of  $Ca^{++}$  on expontaneous contractions of the isolated oesophagus.

It is interesting to remark that abolishing of  $\text{Ca}^{++}$  not only reduces the expontaneous contraction but also the cholinic esther does not act.

It is assumed that the absence of  $\text{Ca}^{++}$  provokes a predominating of  $\text{K}^+$  and so the muscle membrane is depolarized, but it must be also considered that a direct interference of  $\text{Ca}^{++}$  in the sarcoplasm may occur.

The smooth musc'le of the oesophagus of *A. brasiliiana* is also sensitive to different salinities. When the organ is submitted to decreasing of salinity from 100‰ to 20‰ there is a reduction of the expontaneous contractions. These contractions desappear when the salinity falls to 6,54‰ which corresponds to 20% of normal sea water. By normal sea water it is understood the water whose salinity is the same of that of the place where *Aplysia* were collected, that is the sound of S. Sebastião at shore of Araçá, which salinity is arround 30‰. It is also interesting to note that the organ completely recorvers by proportional increasing of salinity from 0‰ to 100‰.

3.

#### References

Sawaya, P. & Cipolli, I. N. 1969. Calcium and the effects of Drugs on Smooth Muscle of the Oesophagus of *Aplysia brasiliiana* (Mollusc-Opisthobranch) — Bol. Zool. e Biol. Marinha, N.S., 26: F — 17, São Paulo.



*Aplysia brasiliana*. Effect of ACh on isolated oesophagus in relation to the amount of Ca<sup>++</sup> in the perfusion fluid.

