

Analysis of trace elements of some edible trematodes parasitizing the bovine hosts

V. Tandon and B. Roy

Department of Zoology, North-Eastern Hill University, Shillong 793 014, India

With the aid of atomic absorption spectrophotometer a qualitative and quantitative analysis of trace element composition of some edible trematode parasites namely, *Gastrothylax crumenifer*, *Fischoederius elongatus*, *F. cobboldi*, *Calicophoron calicophorum*, *Orthocoelium orthocoelium* and *Paramphistomum epiclitum* revealed the occurrence of Cu, Ca, Mg, Mn, Pb, Fe, Ni, Zn, Cr, Cd, K, Se and Co in all the studied species, with K showing the highest concentration and Co the lowest in dry weight of the flukes. Further, Ca, Fe, Zn, Cr and Se were found to be higher in immature and Cu, Mg, Mn, Cd, K and Co were more in mature *G. crumenifer* and *F. elongatus*.

TRACE elements, which are not synthesized in the animal tissue but have significant role in the normal functioning of the body, constitute an important diet among vital foods. However, both excess and deficiency of any one of these metals may lead to toxicity and metabolic, reproductive and skeletal disorders in the body¹.

Among helminth parasites, the paramphistomid flukes recovered commonly and in abundance from the rumen of cattle and buffaloes constitute an unusual food item and a non-traditional source of animal protein relished by the local tribal population of Meghalaya. In context of helminth parasites, trace elements of several cestode and nematode species have been investigated²⁻⁵ and their content found to be species-specific⁶. However, similar information with regard to trematode parasites is relatively scanty^{7,8}. The present communication deals with a qualitative and quantitative analysis of trace elements of the edible trematodes all of which are amphistomid digenea.

Live parasites, namely *Gastrothylax crumenifer*, *Fischoederius elongatus*, *F. cobboldi*, *Calicophoron calicophorum*, *Orthocoelium orthocoelium* and *Paramphistomum epiclitum* were recovered from the rumen of cattle, *Bos indicus*, slaughtered at local abattoirs. The mature specimens of all the six species and also the immature (i.e. without eggs in the uterus) of *G. crumenifer* and *F. elongatus* were washed thoroughly in double distilled water and dried at 100°C for 24 h in an oven. The dried material was ground and 0.5 g of ash from each sample was digested in 5 ml of 2 N nitric acid for 12 h followed by evaporation of the acid at 50°C (ref. 9). This process of digestion was repeated thrice. About 2 ml of HClO₃ was then added to the dried sample and the final volume made to 50 ml. Cu, Ca, Mg, Mn, Pb,

Fe, Ni, Zn, Cr, Cd, K, Se and Co was estimated by atomic absorption spectrophotometer (238A).

The atomic absorption spectra of mature and immature *G. crumenifer* and *F. elongatus* and mature specimens of *F. cobboldi*, *C. calicophorum*, *O. orthocoelium* and *P. epiclitum* indicated the presence of all the trace elements assayed for (Table 1). The overall accumulation of trace metals was found to be highest in *F. cobboldi* followed by *F. elongatus*, *P. epiclitum*, *C. calicophorum*, *G. crumenifer* and *O. orthocoelium*. The amounts of K, Mg, Ca, Fe and Zn were found to be more in all the flukes examined, whereas Co and Cd were in least amount in most of the worms, with the lowest values being in *F. elongatus* and *P. epiclitum*. The results reveal that the quantity of Ca, Fe, Zn, Cr, and Se was higher in immature than mature flukes, while Cu, Mg, Mn, Cd, K and Co were more in mature worms. The values of Pb and Ni do not show any relationship with the maturity of the fluke; while Pb was high in concentration in immature *G. crumenifer* and mature *F. elongatus*, Ni was maximum in mature *G. crumenifer* and immature *F. elongatus*.

High values of K among all the flukes may be accounted for the possible flux of K⁺ between the host and parasite, since helminths are known to show permeability to K⁺ ions¹⁰. Similar to the present observations, Yamane *et al.*³ observed a tendency of Ca, Fe and Zn to increase from immature to gravid proglottid in the cestodes *Diphyllbothrium macrovatum* and *Diplogonoporus balaenopterae*. They suggested that Zn is essential for growth and as a constituent of enzymes, DNA, RNA and protein synthesis. Chowdhury and Singh⁴ also revealed a high level of Zn in growing flukes with active oogenesis and spermatogenesis than the older ones.

Cadmium, though occurring in less amount among all the flukes studied, is known to be very toxic to man as it accumulates in kidney and also affects the reproductive organs. (According to WHO¹¹, the acceptable limit in drinking water is 0.01 ppm.) Likewise, Pb with its permissible intake limit being 0.1 ppm (ref. 11) may also become hazardous if consumed 2-4 ppm over a period of three months. Selenium, an essential element for growth in animals, was also detected in all the edible flukes. An over supply of Se may lead to dullness and lack of vitality to an acute form¹. Comparatively a high level of Co, an integral part of vitamin B₁₂ molecule, in mature worms indicates the probability of high accumulation of vitamin B₁₂ in adult flukes. Excess intake of Co and Mn is also hazardous to human health with implications of cardiac and neurological disorders, inflammation of cells and also inhibition of the key enzymes of glycolysis¹².

When compared with the commercially important traditional fish food like *Sardinella* spp., *Thryssa* spp. and

Table 1. Trace element content in different species of edible paramphistomid flukes (Mean \pm SD: ppm/g dry wt.)

	Cu	Ca	Mg	Mn	Pb	Fe	Ni	Zn	Cr	Cd	K	Se	Co
<i>G. crumenifer</i> (Immature)	14.6 ± 5.1	122.8 ± 29.5	353.0 ± 148.5	6.6 ± 3.0	36.7 ± 17.9	127.1 ± 10.1	8.7 ± 2.8	182.2 ± 47.7	48.1 ± 15.8	1.5 ± 0.8	2185.0 ± 346.8	15.5 ± 5.2	2.5 ± 1.2
<i>G. crumenifer</i> (Mature)	19.9 ± 14.3	100.2 ± 28.6	439.7 ± 240.5	47.9 ± 9.2	4.1 ± 1.9	108.6 ± 27.8	26.4 ± 7.7	42.2 ± 14.4	23.7 ± 4.3	13.6 ± 7.3	2242.0 ± 880.8	7.6 ± 2.7	4.1 ± 1.9
<i>F. elongatus</i> (Immature)	24.7 ± 11.2	164.3 ± 52.5	440.0 ± 118.0	15.8 ± 5.6	14.5 ± 10.5	221.7 ± 88.4	46.8 ± 12.6	154.6 ± 91.3	45.3 ± 3.9	0.9 ± 0.4	1943.0 ± 840.0	9.5 ± 4.0	1.0 ± 0.3
<i>F. elongatus</i> (Mature)	88.5 ± 24.3	94.4 ± 11.5	993.4 ± 359.2	20.3 ± 8.7	24.0 ± 12.0	185.9 ± 23.9	13.1 ± 7.8	73.5 ± 9.5	25.7 ± 13.6	14.6 ± 4.3	3630.2 ± 497.8	5.5 ± 2.6	3.0 ± 1.7
<i>F. cobboldi</i>	22.6 ± 8.8	404.0 ± 86.0	185.3 ± 55.0	50.9 ± 12.7	9.7 ± 5.2	169.1 ± 36.2	52.3 ± 19.7	185.0 ± 49.0	64.9 ± 14.4	10.8 ± 3.8	3448.0 ± 377.0	17.2 ± 3.0	5.3 ± 2.8
<i>C. calicophorum</i>	22.1 ± 6.8	141.0 ± 28.0	399.0 ± 241.0	181.8 ± 46.5	17.0 ± 9.5	109.6 ± 18.4	35.9 ± 12.8	274.0 ± 73.0	37.1 ± 11.0	32.9 ± 5.6	2478.0 ± 540.0	16.4 ± 5.9	3.4 ± 1.4
<i>O. orthocoelium</i>	43.3 ± 34.4	82.1 ± 41.7	292.8 ± 152.4	24.8 ± 16.5	12.3 ± 6.9	154.1 ± 41.9	15.3 ± 9.3	122.4 ± 45.4	57.0 ± 32.7	4.5 ± 1.3	1887.9 ± 633.9	59.5 ± 10.9	7.6 ± 5.6
<i>P. epiclitum</i>	15.2 ± 3.6	139.1 ± 25.0	607.0 ± 103.7	20.7 ± 4.6	7.2 ± 2.5	108.0 ± 29.2	17.8 ± 3.1	48.2 ± 19.4	49.1 ± 14.7	9.6 ± 4.2	2771.4 ± 491.7	6.5 ± 2.2	1.4 ± 0.9

Stolephorous spp., the quantity of Fe, Zn and Mn was found to be much more in edible helminths. Sivakumar *et al.*¹³ reported the occurrence of Fe, 68–110 ppm; Zn, 38–70 ppm; Cu, 20–33 ppm and Mn, 1–22 ppm in dry weight of these fishes.

It is thus evident that these helminth parasites provide a ready source of nutrients required for our normal physiology. However, the occurrence of a considerable amount of Cd and Pb in mature flukes of all the species analysed leads to think about the possible health hazard to the consumers of these parasites.

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