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Comparative Evaluation of the Effectiveness of some local Fabrics for Zooplankton Harvest

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ABSTRACT: A comparative evaluation of the effectiveness for zooplankton harvest for three local fabrics (a white poplin, 120μm; grey baft, 200μm; a nylon, 235μm) and an imported standard zooplankton net of mesh size 76μm were tested in this study. Mesh sizes and gauze constitution of the fabrics were determined with an ocular micrometer under a compound microscope. Filtration efficiency and clogging rates of the fabrics were also measured. All fabrics were effective in harvesting species of the copepods, the cladocerans and the large-sized rotifer, *Asplanchna*. The grey baft and the nylon net were not effective in harvesting the small-sized rotifer species like *Keratella, Filinia* and *Trichocerca*. All the fabrics effectively harvested *Moina*, an excellent freshwater *cladoceran* for fish *larval-rearing*. Clogging rate was found to be a function of gauze constitution, while filtration efficiency was an index of both gauze constitution and mesh size of fabrics. @ JASEM

Freshwater zooplankton for aquaculture purposes range in size from less than 400μm (e.g. *Brachionus calyciflorus)* to about 640μm (e.g. *Moina micrura*). The generally small size of these organisms makes the choice of an appropriate harvest net an important consideration not only in zooplankton field research but also in mass zooplankton culture for larval rearing in fish hatchery operations. In zooplankton mass cultures, choosing a fabric with an appropriate mesh size for harvest is as important as the culture of the organisms (Lavens and Sorgeloos, 1996). The type of fabric/gauze constitution has marked effect on its selectivity, filtration efficiency and clogging (Downing and Rigler, 1984, de Bernardi, 1984).

In the fish hatchery complex of the National Institute for Freshwater Fisheries Research, New Bussa, Nigeria, the Natural live fish food programme is engaged in the mass culture of the freshwater zooplankton, *Moina micrura* for the hatchery rearing of larval *Clarias anguillaris, Heterobranchus longifillis* and their hybrid. Standard imported nets for zooplankton harvest (usually made of fine nylon or silk materials) has been identified as a bottleneck in zooplankton culture and indeed in field zooplankton research as they are not only expensive but largely unavailable in the Nigerian markets. This situation underscores the need to identify and evaluate local fabrics that could be suitable alternatives to the imported ones, for zooplankton harvest. This study was therefore designed to identify and evaluate the effectiveness of local fabrics for zooplankton harvest both for research purposes and for mass collection of cultured zooplankton for fish larval feeding. The overall objective is to reduce or eliminate dependence on imported and expensive net for zooplankton studies

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MATERIALS AND METHODS

Three local fabrics (white poplin, grey baft, and a local nylon material) along with an imported standard zooplankton net were evaluated in this study. The three fabrics were selected as prejudged by the eye (based mainly on invisibility of mesh to the eye) and local availability. In the laboratory the mesh sizes were then determined using an eyepiece ocular micrometer (type 1410A, 20mm diameter disc of 100 units subdivided into 5mm) calibrated with a Reichert stage micrometer (Ovie, 1985). The three fabrics were sewn into a conical-shaped plankton nets using the imported zooplankton net (12cm mouth diameter and 48cm length) as a standard. Twenty litres of water from an earthen fishpond was then passed (filtered) through each of the nets with the filtrate collected in a receiving container. Zooplankton retained by the net was collected in a labelled bottle and preserved in 4% formalin, while five litres of filtrate from each treatment was collected and sedimented in measuring cylinders after addition of formalin and some lugol solution for staining. After about 50 hours, the top layer of the sedimented sample was siphoned-off by capillary using a rubber tubing (5mm diameter) attached to a 5 ml pipette. To avoid accidental loss of zooplankton during siphoning, the mouth of the pipette was covered with a 50 μm mesh nylon net. The filtrate sample was used to test whether a chosen fabric is effective at completely retaining the three main classes of zooplankton (*Copepoda, Cladocera and Rotifera*). Zooplankters in both the net and filtrate were identified and the major ones measured using the ocular micrometer. To test filtration efficiency of the nets, 10 litres of the pond water in a container was passed through each net by using a 2" diameter rubber hose and the time taken recorded. To test clogging rates/properties of the nets, 10 litres of pond

water was filtered through each net every week for 12 weeks and the time recorded. Nets were hung vertically in the laboratory to dry after each use. The duration of 12 weeks was to simulate an annual monthly sampling of natural productive ecosystems (regularly fertilized fishpond) by which time clogging is expected to set in (de Bernadi, 1984). After the last filtration on week 12, the nets were separately soaked in water over-night in mild soap, gently washed and dried. Thereafter, filtration efficiency was again determined as earlier described. Filtration efficiency or clogging rates was calculated as the reciprocal of the time taken for a unit volume of water to completely pass through the nets.

RESULTS

Ocular micrometer determinations of the mesh sizes of the various fabrics in addition to their percent filtration efficiency are shown in Table 1.

Table 1: Mesh sizes of fabrics (ocular micrometer-determined) and percent filtration efficiency

Fabrics	Mesh size (μm)	Filtration efficiency (%)
White poplin (Trt.1)	120± 7.3	60
Grey baft (Trt.2)	200 ±11.3	56
Local nylon (Trt.3)	235 ± 2.6	81
Imported net (Trt.4)	76 ± 0.00	69

The local nylon fabric (commonly used by local women for sieving corn starch, *akamu*) had the largest mesh (235μm), while the standard net had the least mesh (76μm). The white poplin and grey baft are intermediate between these two. The grey baft and the local nylon fabric have similar mesh size but very different gauze configuration. The former and the white poplin have copious interstitial strands of thread criss-crossing the mesh openings (significantly so in the baft material) unlike the local nylon and the imported zooplankton nets. The filtration efficiency (%) of the nets, usually a function of the mesh openings, was in the order Trt.3 > Trt.4 > Trt1 > Trt2 (Table 1). The local nylon fabric therefore had the highest filtration efficiency and was followed by the imported net despite having the least mesh size. This situation is thought to be a function of gauze constitution. Microscopic examination of the filtrate showed that the white poplin (120μm) and the standard imported net (76μm) retained all zooplankton as only the filtrate from the baft (200μm) and the local nylon (235μm) contained zooplankton organisms (Table 2). Organisms in the filtrate however, included only small-sized zooplankters (rotifers) in the genera *Brachionus, Filinia, Keratella and Trichocerca.*

Table 2: Percentage of zooplankton retained by nets and in filtrate of nets

Type of fabric	Mesh size (μm)	%Retained	% in filtrate
White poplin	120 ± 7.3	100	0.00
Grey baft	200 ± 11.3	91.6	8.4
Local nylon	235 ± 2.6	89.3	10.7
Imported net	76 ± 0.00	100	0.00

Common zooplankton groups and species in the filtered plankton sample, including their mean sizes is presented in Table 3. The ability of the various nets to retain members of the major zooplankton groups (cyclopoids, cladocerans, rotifers) is indicated with a positive (+) sign, while a negative sign (-) indicates the converse. The results clearly indicate that the ability of a net to retain a zooplankton species is a function of its mesh size. Consequently, the cyclopoid and the cladoceran species in addition to the large-sized rotifer, *Asplanchna* were retained by all the fabrics tested. On the other hand, none of the fabrics tested could retain the rotifer, *Keratella* that has a size of 72μm. Clogging characteristics of the fabrics (as measured by filtration efficiency with respect to duration of use) was significantly higher in Trt. 1 and 2 (42% and 64% respectively) compared to Trt. 3 and 4 (5% and 4%, respectively). Soaking overnight and gently rinsing on the 13th week substantially improved the filtration efficiency of the white poplin (36%) and the grey baft (53%) as efficiencies were restored to the 5th and 6th week of use, respectively.

Table 3: Size of major zooplankton in sample in relation to mesh sizes of fabrics

Zooplankton	Mean length µm	White Poplin 120µm	Grey baft 200µm	Local nylon 235µm	Imported net 76µm
Cladocerans Cyclopoids	693 ±5 6	+	+	+	+
Moina micrura	610 ± 32	+	+	+	+
Diaphanosoma Rotifers	712 ± 45	+	+	+	+
Brachionus sp	142 ± 15	+	-	-	+
Asplanchna sp.	360 ± 18	+	+	+	+
Filinia sp.	146 ± 12	+	-	-	+
Keratella sp.	82 ± 13	-	-	-	+
Trichocerca sp.	148 ± 17	+	-	-	+

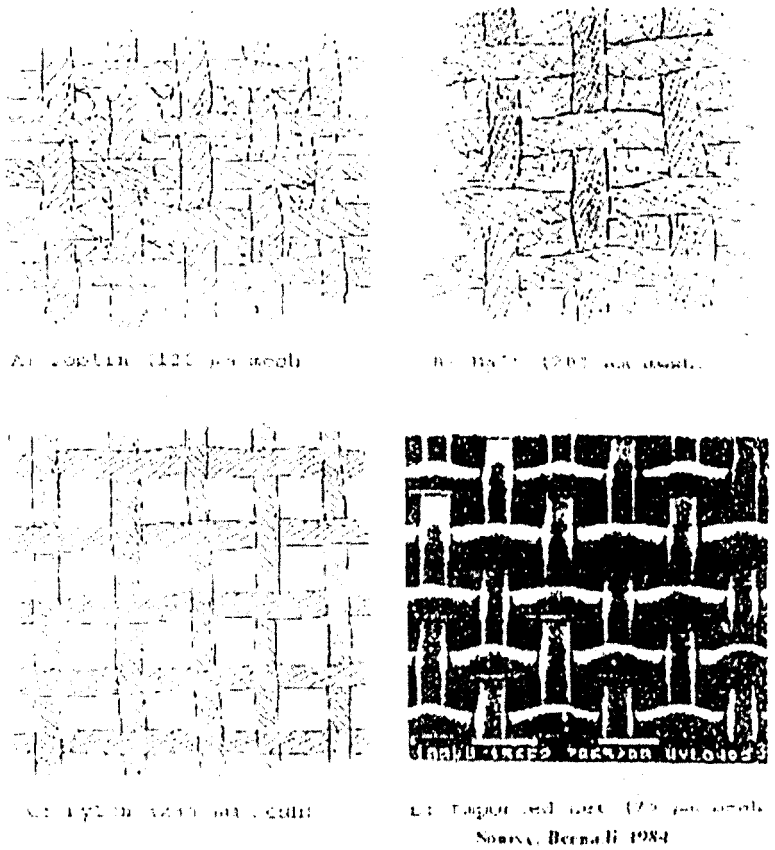

Fig: 1. Nets of different mesh sizes for zooplankton harvest

DISCUSSION

Finding fabrics of appropriate mesh sizes is a major consideration in zooplankton field research and mass zooplankton cultures for fish larval rearing (Ovie *et al.*, 1993; Lavens and Sorgeloos, 1996; Ovie and Egborge, 2002). This is so because of the usually small size of the organisms, which for aquacultural purposes usually range in size from about 140µm (members of the genus *Brachionus*) to about 700µm (mainly *Daphnia* and *Moina* sps). Identifying an appropriate fabric for the construction of zooplankton harvest net is therefore as important as the culture techniques for the organisms themselves.

Results of this study indicate and confirm that local fabrics such as the white poplin (120µm), grey baft (200µm) and the local nylon fabric for sieving corn starch (235µm) are possible and cheap alternatives to imported zooplankton harvest nets. The latter is

largely unavailable in the Nigerian markets and are also very expensive thus making their use uneconomical especially for zooplankton mass harvest. Except for the very small-sized rotifers like *Keratella,* the fabrics were effective in harvesting members of the three major groups of zooplankton namely, *Copepoda, Cladocera and Rotifera.*

A number of factors are known to affect the efficiency of fabrics used for zooplankton harvest. De Bernardi (1984) listed some of these factors to include the characteristics of the fabrics (fabric type and nature of the gauze), mesh size, filtration efficiency and clogging properties. Attempts to assess these factors in this study revealed the following:

Nature of the fabrics and clogging properties: The local nylon fabric and the imported zooplankton net (Fig 1) have better quality gauze constitution (absence of interstitial threads) compared to the other two. Gauze constitution was worse with the baft fabric because of copious interstitial strands of threads, which interfere with mesh openings. These strands hinder filtration and facilitate clogging of fabrics and consequently not a good harvest or collection net on the long run. This is exemplified by the higher degree of clogging observed for the white poplin (42%) and the grey baft (64%) at the end of 12 weeks of consecutive use. The practice of soaking overnight and gentling rinsing thereafter improved their filtration efficiency substantially. This practice could be employed regularly to ensure long term efficiency of zooplankton nets as even the best synthetic nets are known to experience clogging on the long run (Tranter and Fraser, 1968).

Mesh size and filtration efficiency of fabrics: It is known that the larger the mesh size, the greater the filtration efficiency of zooplankton nets if the fabrics used in constructing the net is of good quality gauze constitution (de Bernardi, 1984). *De jeure* therefore, the order of filtration efficiency, considering the mesh sizes of the fabrics would have been Trt.3 > Trt.2 > Trt.1 > Trt.4 but d*e facto* the order was treatment Trt.3 > Trt.4 > Trt.1 > Trt.2. The greater filtration efficiency of the imported net despite its smaller mesh size compared to the poplin and baft confirms that the nature and gauze constitution of fabrics is important to filtration efficiency. Overall, the mesh size of the fabric determines the size of organisms it can capture. As revealed in this study, all the fabrics tested are capable of collecting the copepods and the cladocerans including their instars. They were also found to be effective in collecting the large-sized rotifers such as *Asplanchna* and to some extent *Brachionus* that are good aquacultural species for larval feeding. Like the replacement of imported *Artemia* with the indigenous freshwater zooplankton, *Moina* in fish larval rearing (Ovie *et al.*, 1993, and Ovie and Egborge, 2002), this study has shown that locally available local fabrics are good and inexpensive fabrics for zooplankton harvest. In particular, the local fabric, poplin can be employed even in field research, as it was more effective in harvesting a broader spectrum of available zooplankton populations. Overall, the study has the potential of enhancing zooplankton field research/mass cultures and most importantly of reducing the cost of fish seed production in fish hatcheries.

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