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EVALUATION OF METHODS OF PROCESSING PATHOGEN–FREE POULTRY DROPPINGS FOR FISH-CUM-POULTRY CULTURE

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ABSTRACT

Four local methods of processing poultry droppings for fish-cum-poultry culture system were evaluated to identify methods with pathogen-free poultry droppings that will be most suitable for fish culture as against the use of raw poultry droppings. Steam-heating, cooked and oven-dried, sun dried and roasted dried methods were employed to process poultry droppings for fish culture. One gram of raw and of each processed droppings were prepared separately by 10 fold serial dilution with 1litre distilled water. Bacteria counts were determined using the spread plate count on nutrient agar in triplicates after incubation at 28^0C for 18 h. The sun-dried had *E. coli* and unidentified aerobic spores of fungi while roasted dried droppings had only *E. coli*. The raw poultry droppings had significantly (P<0.05) higher microbial counts than the processed droppings. Laboratory analysis shows that bacteria and fungi were the dominant contaminants of raw poultry droppings. Micro-organisms isolated and identified in the raw poultry droppings were *Pseudomonas, Escherichia coli, Flavobacterium, Streptomycetes, Streptococci,* aerobic spores and unidentified flagellated protozoan. Microbial counts of the sun-dried and roasted dried poultry droppings were not significant (P>0.05) different. Likewise microbial counts of steam-heated and cooked oven-dried droppings were not significant at P>0.05. However, the sun-dried and roasted dried poultry droppings had significantly (P<0.05) higher microbial counts than the steam-heated and cooked oven-dried droppings. The steam-heated and cooked oven-dried methods may be considered as being pathogen-free for fish culture. Cooked oven-dried method is however recommended since no trace of pathogens was found in pure cultures.

KEY WORDS*:* Poultry droppings, pathogen-free, fish culture.

INTRODUCTION

Feeding animal waste to fish is an old practice. However, the significance of poultry waste in aquaculture is relatively new. Poultry waste may be used indirectly acting as manure to support fish production or directly as a food source. Poultry manure is now widely used in commercial freshwater aquaculture for its nutrient-rich waste and cost effectiveness. Animal wastes have been used to replace 50% feed with a resulting increase in fish production in intensive aquaculture (Meyer, 1977). Poultry production waste have been reported to have inherent qualities that make them particularly valuable for fish production compared to other livestock wastes and can be processed in so many ways to reduce contaminants (Agriculture and Agri-food Canada,1990). Poultry wastes have been found to have a proportion of the nutrient content of feed voided as faecal waste acting as fertilizers to produce natural food organisms in fish culture. Tropical and silver carp, catfish and tilapia have been reported to have enormous potential for utilizing animal wastes (Durham *et al*., 1966). According to Taiganides (1978), poultry manures are nutrient-rich, but have great variability in terms of nutrients available which may be due to quality of poultry feeds, food conversion efficiencies and other factors.

The acceptability of poultry wastes in feed formulation on a large scale has been reported to be low due to its high moisture content (75-80%) and high level of protein which predisposes it as a veritable medium for the sustenance and proliferation of micro-organisms (Akpodiete and Okagbare, 1999). There is possible transfer of pathogenic organisms voided from unhealthy animals or present in the environment through a diet containing poultry wastes. Public health concerns have been raised about the integration of poultry and fish production due to the risks of direct pathogen transfer to humans in fish ponds fertilized with manures (AIT, 1986; Buras, 1993). Several methods have been used to process poultry waste to reduce its moisture content and possible contaminants. Kese and Donkoh (1982) used steam- heating and reported the absence of microbial growth when samples of manure were cultured. Roasting and sun drying have also been used (El Boushy and Van der Poel, 1994).

The production of pathogen-free poultry waste is of great importance to prevent possible transfer of pathogens to man through fish fed microbial-contaminated poultry manure. This paper evaluates local methods of processing pathogen-free poultry droppings for use in integrated fish-cum-poultry culture in Asaba, Nigeria.

MATERIALS AND METHODS

Poultry droppings were collected with sterile five litre plastic bucket from the DIL Poultry Farms in Delta State University, Asaba Campus, Asaba in 2009 and transported to the Department of Fisheries laboratory for analysis of micro-organism contamination. Four methods of processing poultry droppings were evaluated and compared with raw poultry droppings. Steam heating was done by passing steam through the manure for a period of time using two metallic drums with one having perforations at the bottom and sides and the other whole according to Kese and Donkoh (1982). Roasting dry was carried out by the application of direct heat to the droppings in a large frying pan heated from the bottom with heat generated from wood at a temperature range of 102 to 105^{0}C (Akpodiete and Okagbare, 1999). The droppings were stirred constantly to prevent burning and ensure uniform heat transmission to hasten the drying process. Cooking of poultry droppings was done by boiling two part manure in one part water for 24 h and oven dried according to Ilian and Salman (1986). Sun drying of poultry droppings was done by spreading thinly 10g droppings on a flat metal sheet and sun dried in the open on a sunny day. After each method of processing, the droppings were allowed to cool and thereafter examined under hygienic conditions.

One gram of raw and of each processed droppings were prepared separately by 10 fold serial dilution with 1litre distilled water. Bacteria counts were determined using the spread plate count on nutrient agar in triplicates after incubation at 28^{0}C for 18 h. Micro-organisms were isolated, pure cultures made and isolates identified and characterised according to Olutola *et al.* (2000). Ten mls of the raw poultry suspension was poured into test tube and centrifuged at 5,000 rpm 3 mins. The supernatant was decanted and a drop of the sediment was put on a slide and examined under the microscope (x100) for protozoan content. Data collected were analysed with analysis of variance test and significant means separated with Duncan Multiple Range Test (DMRT) at P<0.05.

RESULT

Out of four processed poultry droppings examined, two had bacterial contamination. Sun-dried and roasted or dried poultry droppings had bacterial contaminants while the steam-heated and cooked oven-dried had no contaminants. The sun-dried had 1.10 x 10^{6}cfug^{-1} of *E. coli* and unidentified aerobic spores of fungi were 0.54 x 10^{6}cfug^{-1}. While roasted dry droppings had only *E. coli* (Table 1). Laboratory analysis shows that bacteria and fungi were the dominant contaminants of raw poultry droppings. Micro-organisms isolated and identified in the raw poultry droppings were *Pseudomonas, Escherichia coli, Flavobacterium, Streptomycetes, Streptococci,* aerobic spores and unidentified flagellated protozoan. Micro-organisms of raw poultry droppings and counts are presented on Table 2.

TABLE 1. Isolates from different processed poultry droppings and counts (10^{6}cfug^{-1}).

Processed poultry Droppings	*Pseudomonas*	*E. coli*	*Streptomycetes*	*Streptococci*	*Flavobacterium*	Aerobic spores	Flagellated Protozoan
Sun-dried	-	1.10	-	-	-	0.54	-
Steam heating	NP	0.12	NP	NP	NP	NP	NP
Cooked & oven dried	NP	NP	NP	NP	NP	NP	NP
Roasted or dried	-	0.82	-	-	-	-	-

NP- not present

The raw poultry droppings had significantly (P<0.05) higher microbial counts than the processed droppings. E. coli followed by Flavobacterium had the highest microbial counts of 2.51 x 10^{6}cfug^{-1} and 2.20 x10^{6}cfug^{-1} respectively. Microbial counts of the sun-dried and roasted dried poultry droppings were not significant (P>0.05) different. Likewise microbial counts of steam-heated and cooked oven-dried droppings were not significant at P>0.05. However, the sun-dried and roasted or dried poultry droppings had significantly (P<0.05) higher microbial counts than the steam-heated and cooked oven-dried droppings.

TABLE 2. Micro-organisms of raw poultry droppings and counts.

Micro-organisms	Counts
Pseudomonas (10^{6}cfug^{-1})	1.20
E. coli (10^{6}cfug^{-1})	2.51
Streptomycetes (10^{6}cfug^{-1})	0.89
Streptococci (10^{6}cfug^{-1})	1.80
Flavobacterium (10^{6}cfug^{-1})	2.2
Aerobic spores (10^{6}cfug^{-1})	1.4
Flagellated protozoan (cells/ml)	1.6

DISCUSSION

Micro-organisms were isolated from the cultured sun-dried and roasted or dried as well as in the raw poultry droppings. This is an indication that most poultry droppings used in fish culture may be contaminated with micro-organisms. Poultry droppings normally contain extraneous substances in its raw form. These substances may present unfavourable conditions to fishes when applied in raw forms as nutrient source or as fertilizers to stimulate production of natural food organisms to boost fish production. Unprocessed poultry droppings are not unlikely to contain contaminants due to exposure to contaminants in the poultry environment. Sun drying of poultry droppings is cheap but has been reported to be inefficient in sterilizing raw poultry droppings freeing it from pathogenic organisms (Akpodiete and Okagbare, 1999). Steam-heated and cooked oven-dried droppings were free of microbes. The subjection of droppings to high temperatures during processing may have killed all the pathogenic organisms present in the raw droppings. El Boushy and Poel (1994) reported that high temperature reduces the moisture content of poultry droppings to about 10-15% and this reduces the population and ability of micro-organisms to proliferate. Drying has been reported to reduce the nutritive value of poultry waste depending on the age of droppings before drying, moisture content when fresh, method of storage, type, age and physiological status of the bird, the processing method and the speed of drying (Ologhobo and Oyewole, 1987).

In view of the variation and probable reduction in the nutritive value of droppings, the use of poultry droppings as fertilizer to boost production of natural food organisms may be more beneficial than its usage as a food source. Sin (1980) reported fish kill caused by a continued build up of poultry wastes resulting in subsequent bacterial, plankton bloom and oxygen depletion. While processing of poultry droppings before use in fish production eliminates micro-organisms to a large extent, the use of raw droppings introduces pollution of fish ponds due to its organic nature (Adewunmi *et al.,* 2011). The use of raw poultry droppings may have negative effects on the water quality of fish ponds as it may introduce micro-organisms into pond water. Offensive odour emanating from the droppings may also constitute problem in waste-fed ponds. The use of raw poultry droppings has necessitated the need for pollution control in order to prevent oxygen depletion by waste-degrading microbes. With proper management however, pollution can be controlled. This study has shown that processing of poultry droppings using steam-heated and cooked oven-dried methods before application to fish ponds are preferred methods to ensure pathogen-free fish and fish ponds and also enhance high fish yields.

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