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Cultivation of Tanzanian *Coprinus cinereus* (sisal compost mushroom) on three non-composted sisal waste substrates supplemented with chicken manure at various rates

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ABSTRACT

Coprinus cinereus is a Tanzanian wild edible mushroom whose cultivation in the laboratory was performed in solid-state fermentation bioreactors using sisal decortication wastes namely; sisal dusts, sisal fibres and sisal leaves as basal substrates supplemented with chicken manure at various rates. Bioreactors containing 450 g wet weight of the three sisal wastes substrates each was supplemented with dry chicken manure at 0% (un-supplemented control), 5%, 10%, 15%, 20% and 25% of substrate dry weight. The effect of the test sisal waste substrates and chicken manure of various supplementation rates were evaluated by mushroom yield, (g fresh mushroom/kg moist substrate) and its biological efficiency, B.E. (relationship between fresh mushroom weight and dry substrate weight as percentage) and mushroom size (a ratio of total weight of fresh mushroom and total number of mushrooms). Each, sisal waste substrate and chicken manure supplement at various rates showed variable impact on mushroom yield, productivity and size. The overall best results of mushroom production were obtained in sisal dust at 25% chicken manure in terms of mushroom yield 381 g fresh mushrooms/kg moist substrate weight and its B.E. of 112% while mushroom size best results of 1.64 was obtained at 15% manure. In conclusion, results suggest that chicken manure from free-range chicken may play an important role on increasing the yield and productivity of *Coprinus cinereus* on sisal waste substrates under the conditions investigated.

Keywords: Mushroom yield, biological efficiency, crop cycle

INTRODUCTION

Mushroom cultivation can be a small-scale subsistence and primitive farming activity using low technology approaches. On the other hand, it can be a large-scale industrial or commercial venture, which employs sophisticated high technology approaches (Stamets, 2000; Oei, 2003). Mushrooms have been recognized as high potential bioconverters of inedible organic biomass wastes into valuable protein rich food and a cash crop of commercial interest (Poppe, 2000). Members of the genus *Coprinus* are coprophilic, frequently found growing on dung and wide spread in temperate, subtropical and tropical regions of the world (Ndyeitabura et al., 2010). *Coprinus* species are readily noted in the field where

they grow in heaps of dung, rotten straw, vegetable refuse, lawns, decaying grass, recently disturbed soils, compost piles, sawdust, sisal waste compost and other decomposed lignocelluloses substrates (Härkönen et al., 2003; Mshandete and Cuff, 2008; Ndyeitabura et al., 2010).

Coprinus cinereus belongs to genus *Coprinus*, black-spored family Coprinaceae in division Basidiomycota. All species go through an auto digestion at maturity in which the gills liquefy into a black, inky substance (Härkönen et al., 2003; Ndyeitabura et al., 2010). Several *Coprinus* species are known and are used for food and medicinal purposes in many parts of the world (Desai and Peerally, 1990; Stamets, 2000; Mshandete and Cuff, 2008; Ndyeitabura et al., 2010).

Cultivation of some wild *Coprinus* species has been reported on composted or non-composted substrates. For example, Kurtzman (1978) used straw supplemented with calcium nitrate to grow *Coprinus fimentarius* while Stamets (2000), reported cultivation of *Coprinus comatus* on wheat straw/horse/chicken manure compost. Furthermore, Chaiyama et al. (2007), reported suitability of non-composted mixture of pararubber sawdust, kapok waste and boiled sorghum as substrate to grow *Coprinus comatus*. More recently sisal waste compost has been found to be a novel substrate for the cultivation of a newly domesticated Tanzanian *Coprinus cinereus* mushroom (Mshandete and Cuff, 2008). The Tanzanian *Coprinus cinereus* has also been reported to be a good source of protein, ascorbic acid, fiber and minerals (Mshandete and Cuff, 2007). Also most recently, it has been shown that *Coprinus cinereus* extracts contains bioactive components, which are potential sources of antimicrobial compounds that could be used for development of new drugs for the treatment and prevention of diseases (Ndyeitabura et al., 2010). Therefore, *Coprinus cinereus* is thus an edible fungus that matches the request of natural, nourishment and health care.

Attempts to produce high yield and quality mushrooms crops as well as shortening mushroom production periods are regarded world wide amongst important scientific components in the mushroom industry (Frimpong–Manso et al., 2010). In this regards previous findings have demonstrated that additives such as rice bran, cassava peels, carbohydrates, natural extracts like yeast and malt extract added to the substrates at spawning resulted on significant increase in mushroom cumulative yields (Stamtes, 2000; Oei, 2003). Some studies have also shown that supplementation of protein rich organic wastes like ground pigeon pea, soybean, chicken manure, fish wastes and dung manure strongly enhanced yields of cultivated mushrooms (Royse et al., 2003; Atikpo et al., 2008). Furthermore, high mushroom yield may also be stimulated by supplementation with vegetable oil, soybean meal, post-anaerobic effluent, commercial supplements and amino acids to cultivation media (Royse, 2002; Yang et al., 2003; Pant et al., 2006; Royse and Sánchez, 2008; Royse et al., 2008; Frimpong-Manso et al., 2010). On the other hand, addition of *Scytalidium thermophilum* (*St*), a thermophilic fungus to the substrate has been recently reported to enhance mushroom yields of a cultivated mushroom and increase selectivity of the substrate (Sánchez and Royse, 2009). In addition rice husks have been reported to contain mycelium growth stimulating promotors that might lead to new profitable cultivation of mushroom species such as *Coprinus cinereus* (Hanai et al., 2005). However, in the literature so far information on the effect of chicken manure on mushroom size, yield and productivity of *Coprinus cinereus* grown on non-composted sisal wastes substrates is totally non-existent.

Biomass availability is a primary factor for biobased products production. Chicken manure is among the organic fertilizers available in large quantities in Tanzania. According to 2002 chicken census Tanzania had 27 million population of free-range chickens (*Gallus gallus domesticus*). Elsewhere average manure production per

chicken has been estimated at 0.139 kg per day with dry matter content of 22% (Thomsen, 2004). Based on 27 million free-range chickens about 1,370,000 tons of fresh chicken manure equivalent to about 301,400 tons dry matter could be generated annually in Tanzania. Sisal industry in Tanzania also generates huge quantities of sisal decortication wastes namely; sisal fibers and sisal leaf estimated at about 1,125,000 tons per annum (Mshandete et al., 2008). These wastes are underutilized and disposed of untreated leading to negative environmental and economic effects related to their disposal. The present study was therefore carried out to investigate the influence of chicken manure as an additive to non-composted three sisal decortication wastes as substrates with a resultant effect on the biological efficiency, mushroom size and mushroom yield of Tanzanian *Coprinus cinereus* (Schaeff) S. Gray s.lat.

MATERIALS AND METHODS

Coprinus cinereus (Schaeff) S. Gray s.lat

Coprinus cinereus previously classified as species of Agaricaceae is currently named as *Caprinosis cinerea* classified under Psathyrellaceae (Redhead et al., 2001; Srivilai and Loutchnwoot, 2009). However, in this paper the name *Coprinus cinereus* (Schaeff) S. Gray s.lat of Tanzanian material established by conventional morphological taxonomy by Härkönen et al. (2003) was used until molecular characterization of Tanzanian material established. For simplicity, *Coprinus cinereus* (Schaeff) S. Gray s.lat was referred to by the species name as *C. cinereus* only in the rest of the paper. Immature/button stages of the fruiting bodies of *C. cinereus* (Figure 1) were collected from sisal decortication waste dumpsite at Alavi sisal estate, a private sisal processing factory owned by Mohamed Enterprises at Soga-Kongowe, Kibaha, Coast region, Tanzania, where they grow in nature. These mushrooms were brought to the laboratory the same day for tissue culture.

Sisal decortication wastes and chicken manure

Sisal decortication wastes (sisal dust, sisal fibres and sisal leaves) were obtained from sisal processing factory at Alavi sisal estate. Sisal wastes were packed separately and brought to the laboratory at the Department of Molecular Biology and Biotechnology, College of Natural and Applied Sciences, University of Dar es Salaam. Sisal fibres and sisal leaf decortication wastes were sun dried for seven days. Fresh free-range chicken (*Gallus gallus domesticus*) manure (chicken droppings) was obtained from local poultry keepers at Upanga, Dar es Salaam, Tanzania and was sun dried for seven days and ground to fine powder using a laboratory blender (Snijders Scientific Tilburg, Holland, Waring Blender, Torrington, CT, USA). In order to avoid changes of compositions, both solid sisal wastes and chicken manure were kept at -20 °C until when used. The composition of sisal dust, fresh and dry chicken manure is reported elsewhere (Mwita et al., 2011). Sisal leaf and sisal fibres decortication wastes compositions have been reported by Mshandete et al. (2005, 2006).

Mushroom cultivation

Source of strain

Immature stages of the fruiting bodies of *C. cinereus* were collected from the piles of decomposing decortication sisal wastes. The mycelia of this mushroom were aseptically obtained following the tissue culture protocol in the laboratory according to Mshandete and Cuff (2008). The fruiting body was split into halves to expose the inner tissues and a sterile scalpel was used to cut thin layer of the inner tissue, which was inoculated in the pre-sterilized Petri dish containing sterilized malt extract agar (MEA) media procured from (Oxoid, Unipath Ltd, Basingstoke, Hampshire, England). The plates were then incubated upside down for 7 days at room temperature to allow mycelia to grow on the media. The sub culturing of the isolate on the same media was used to maintain the pure culture (Figure 2).

Spawn preparation

Spawn (mushroom seed) preparation of *C. cinereus* was done according to Mshandete and Cuff (2008) using intact sorghum grains, which were bought from Kariakoo market in Dar es Salaam, Tanzania. After draining excess water, 150 g of the grains were packed in 330 mls wide mouth bottles (Kioo Ltd, Dar es Salaam) and sterilized in an autoclave for one hour at 121 °C and 1.54 kg/cm^2 in a 17 litres autoclave (International pbi Sp, Milano, Italy). After cooling to room temperature, each cooled bottle of sterilized grains was aseptically inoculated in the laminar flow with three 1cm^2 pieces of pure mycelium MEA taken from 4 day-old cultures of *C. cinereus* and were incubated with their caps loosely tied in a ventilated incubator (Memmert GmbH KG, Schwabach FRG, Germany) set at 28 ± 2 °C for 10 days. The mother spawn was used to prepare more spawn for inoculating bulky substrates.

Cropping container

Cultivation of *C. cinereus* on sisal decortications wastes as basal substrates was carried out in solid-state fermentation bioreactors (SSFBs) which consisted of 3 litres rectangular plastic containers with dimension of 23 cm x14 cm x 9 cm (length, width and height, respectively) (Cello® Domestoware (Mkate), Dar es Salaam, Tanzania). A total of 136 aeration holes of 0.7 cm in diameter and 3 cm apart were made in all the sides of the bioreactor to facilitate aeration during spawn running.

Mixing of sisal waste substrates with chicken manure and their inoculation

The basal substrates used were sisal decortication wastes: dust, leaves and fibres. They were added with amount of water enough for making it moist. Every substrate and dry chicken manure were pasteurized at 70 °C for three hours (Koninklijke AD Linden JR.BN-Zwijinderect, Holland). Thereafter, the substrates and chicken manure were left to cool before they were mixed. Four hundred fifty grams of the substrate was introduced in each bioreactor and the weight of the chicken manure introduced in the bioreactor depended on the percent of supplementation. The supplementation of chicken manure was based on the dry weight of the substrate. Each substrate was supplemented with 5%, 10%, 15%, 20% to 25% of chicken manure from domestic chicken free range. The detail of the mixtures of sisal waste substrates (wet weight) and chicken manure (dry weight) loaded in SSFBs are reported elsewhere (Mwita et al., 2011). There were control SSFBs in which no chicken manure was added, labelled as 0% supplementation i.e. contained the substrate only. The spawn rate employed was 5% based on wet weight of the substrate (about 23 g per 450 g moist weight substrate). After inoculation, the SSFBs were incubated for spawn running in a spawn running room as per Mshandete and Cuff (2008) recommendations. The experiment conducted in SSBRs comprised of a split-split plot design, triplicates with sisal waste substrates as the main plot, varying chicken manure supplementation levels as the sub-plot treatment.

Spawn running (mycelia development), pinhead initiation and fruit body formation

Spawn running was followed by direct observation of the inoculated substrates until the substrates were completely invaded with mycelia. Contaminants such as of the genus *Aspergillus* and *Trichoderma* were also observed and noted but not quantified. The number of spawn run days for mycelia to colonize the substrate was recorded. During spawn running and fructification humidity and temperature were recorded using weather forecast clock (which simultaneously measures temperature and humidity) (Bright Weather Care, Scholer Quartz, Swiss). The conditions during spawn running in the room were 28 ± 2 °C and relatively air humidity 78 ± 2. Once the mycelia of *C. cinereus* strain had grown throughout the whole substrate the SSFBs were removed and transferred to a fruiting room. The fruiting body formation of *C. cinereus* was triggered by manipulating the

environmental variables namely: moisture, air exchange, temperature and light in the cropping room as reported by Mshandete and Cuff (2008).

Harvesting and determination of biological efficiency (B.E.), mushroom yield (M.Y.) and mushroom size

To prevent damage to the growing mushrooms and the developing primordia, the harvestable fruiting bodies were carefully lifted up, shaken left and right then up and down and finally were twisted off as described by Praphant (2005). Fresh *C. cinereus* fruiting bodies were harvested when young, firm and flesh (immature/juvenile/button stage) that is recommended harvesting stage according to Mshandete and Cuff (2008). When the mushroom caps disintegrates, turning into an inky mass, they were considered over matured and hence not suitable as food/inedible according to Härkönen et al. (2003). At the time of harvesting, fresh mushrooms collected from SSFBs were counted and weighed for the average mushroom size, yield and biological efficiency were calculated. Dates of each harvest were recorded and total duration of time from inoculation to final harvest for the various treatments investigated were recorded. Three aspects of mushroom crop yield and productivity were evaluated according to Royse et al. (2004): (i) Mean mushroom size was determined as follows: total weight of fresh mushrooms harvested/total number of mushrooms harvested. (ii) Biological efficiency (B.E.) was determined as the ratio of (g) fresh mushrooms harvested per (kg) dry substrate weight including the supplement weight g expressed as percentage and (iii) mushroom yield (M.Y.) was determined as weight of fresh mushrooms harvested (g) per (kg) moist substrate weight including the supplement weight.

Statistical analysis

The data on mushroom size, mushroom yield, and biological efficiency of *C. cinereus*, cultivated on three sisal decortication wastes supplemented with various amounts of chicken manure were subjected to analyses of variance (one-way ANOVA) when significant differences were determined post test were made using Turkey multiple range test. The results are given as mean ± SD.

RESULTS

Days for mushroom production and crop cycle

In this study the time for the production of fruit bodies of *C. cinereus* differed in the three sisal waste substrates regardless of their supplementation levels ($p<0.05$). The mycelium on average completely spread through the sisal waste substrates supplemented with various amounts of chicken manure in about 4-6 days after spawning. It took 1-2 days from the appearance of minute fruiting bodies until mushrooms were ready for harvesting. The results showed that days for production of harvestable fruiting bodies was in the order of 6 days for sisal dust wastes, 7 days for sisal leaves wastes and 8 days for sisal fibers wastes. On the other hand, the entire crop cycle in this study took on average 21 days in although some cases went up to 28 days (results not shown).

Mushroom size

Mushroom growth both quantitatively and qualitatively is affected by nutritional factors involved in mushroom substrate. Sisal dust waste gave the relatively largest mean mushroom size (1.64) at 15% chicken manure supplementation, followed by sisal leaves while sisal fibres gave the smallest mushroom size (Figure 3).

Mushroom yield

Analysis of mushroom yields revealed statistically significant differences ($p< 0.0001$) among the three sisal decortication substrates and various chicken manures. These results demonstrated that mushroom yields are directly related to the types of substrates and supplement concentrations (Figure 4). Chicken manure supplementation levels at 5%

for sisal leaves waste and at 25 % for sisal dust wastes were the best supplement levels for increased mushroom yield and productivity.

Biological efficiency

Results in (Figure 5) clearly demonstrated that the biological efficiency (B.E.) percentage of mushroom production from three sisal decortication wastes supplemented with chicken manure at various amounts differed and were statistically significantly different ($p<0.0001$). Generally B.E.% for sisal dust and sisal fibres waste substrates increased as chicken manure supplementation level was increased up to 25%. In contrast, for sisal leaves waste an increase beyond 5% chicken manure supplementation led to progressive decrease in mushroom productivity. Such differences could possibly be due to certain components and microenvironments in the three sisal wastes basal substrates as well as contents in the chicken manure that were not known in this research that influenced the mushroom productivity. The poorest B.E. in the range of 2 to 17% was obtained from sisal fibres waste while sisal leaves waste B.E. ranged between 31 to 119%. On the other hand, B.E. range of 48 to 112% was obtained from sisal dust waste. The highest B.E. of 119% for sisal leaves wastes and 112% for sisal dust wastes were obtained at 5% and 25% chicken manure supplementation levels respectively.

Figure 1: Immature stages of the fruiting bodies of wild edible *C. cinereus* in natural habitat decomposing sisal decortication wastes in Tanzania.

Figure 2: Pure mycelia culture of wild edible *C. cinereus* growing on the Petri dish containing MEA after tissue culture of the immature fruiting body.

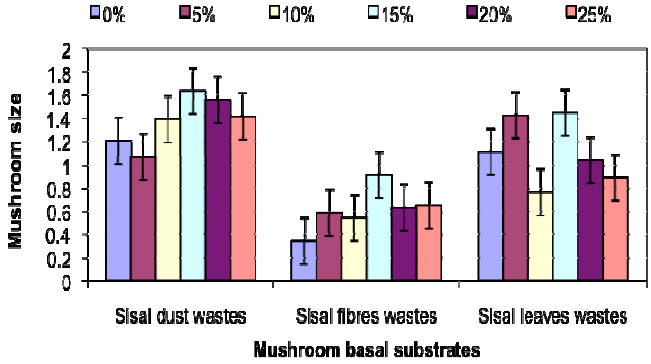

Figure 3: Mean values of *C. cinereus* mushroom size harvested from three sisal decortication wastes at various chicken manure percentage supplementation levels. Mushroom size values in all three sisal wastes substrates at 10%, 15% and 25% were statistically significant while at 0%, 5% and 20% were not different statistically at 5% probability using Tukey-Kramer Multiple Comparisons Test.

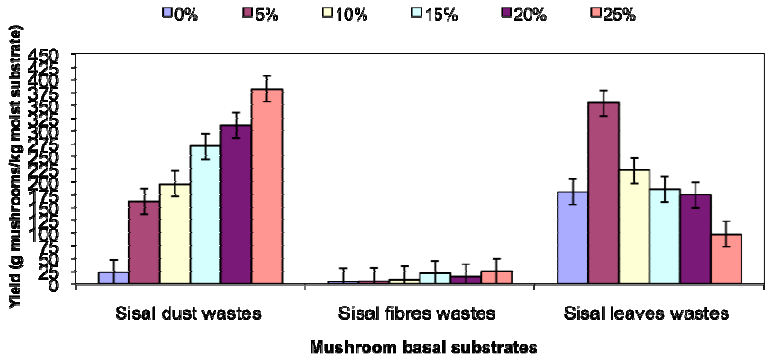

Figure 4: Mean values of *C. cinereus* mushroom yield harvested from three non-composted sisal decortication wastes at various chicken manure percentage supplementation levels.

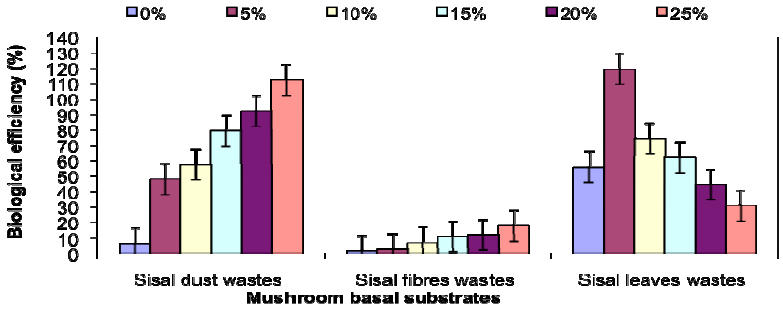

Figure 5: Mean values of *C. cinereus* B.E.% of mushrooms production from three non-composted sisal decortication wastes at various chicken manure percentage supplementation levels.

DISCUSSION

Solid sisal processing wastes (sisal fibers, sisal leaves and sisal dusts) were utilized in this study due to the facts that saprotrophic mushrooms have been cultivated on different kinds of lignocelluloses substrates obtained from agro-industrial activities (Poppe, 2000; Hanai et al., 2005). Chicken manure were used as additive/supplement to sisal wastes cultivation substrate for *C. cinereus* because it has been found that when plant wastes constituting mushroom substrates

are supplemented with protein-rich materials such bran of wheat and rice fruiting body formation is enhanced considerably (Frimpong–Manso et al., 2010). However, prior to this study there is no report yet on the influence of chicken manure as a possible supplement to three non-composted sisal decortication wastes basal substrates to ascertain its contribution to days for mushroom production, mushroom size, mushroom yield and biological efficiency of Tanzanian wild edible *C. cinereus* mushroom.

Reduction of time required for mushroom production is one of the keys to reduce running costs of mushroom growing facilities (Hanai et al., 2005). For this purpose previous investigations have demonstrated that shortening of cultivation period of mushrooms can be achieved by addition of additives/supplements to the cultivation substrate of which varies from species to species (Royse, 2002; Royse et al., 2004). In this study, the time for the first appearance of mushrooms was 2-5 days which was shorter compared to the range of 10 to 11 days reported previously for similar *C. cinereus* grown on sisal wastes compost (Mshandete and Cuff, 2008). The main reason for earlier appearance of mushrooms in the present study compared to the previous is possibly the protein stimulatory effect of chicken manure supplemented non-composted sisal waste basal substrates. A similar observation have also been recently reported by Reyes et al. (2009) in which sawdust supplemented with protein rich rice grit led to early fructification of *Coprinus comatus* 8 days after inoculation compared to saw dust supplemented with rice bran, which took 17 days for mushrooms to appear. On the other hand, crop cycle in this study, which took on average 21 days, correlated well with crop cycle of 21-23 days reported for *C. cinereus* grown on sisal waste compost (Mshandete and Cuff, 2008) and that of 20 days reported earlier by Kurtzman (1978) for *Coprinus fimetarius* Fr cultivated on straw supplemented with calcium nitrate, ammonium nitrate and limestone. The production period of *C. cinereus* seems to be quite short and lasts only in average for one month. Thus mushroom growers can grow 10-12 crops per year and produce large crops. Due to easy cultivation, *C. cinereus* can be particularly suitable for cultivation in Tanzania's rural and per-urban as an alternative source of protein rich food and income.

Mushroom size of fresh mushrooms occupies a significant role during grading, packing and distribution of mushroom as well as on the market quality of mushrooms. For example big size and button unopened *Coprinus* mushrooms attract highest return in the market place (Praphant, 2005; Reyes et al., 2009). In this study the relatively largest mean mushroom size (1.64) was obtained from mushrooms harvested on sisal dust waste at 15% chicken manure supplementation level. However, mushroom size varied in response to three sisal waste cultivation media and various chicken manure supplementation rates (Figure 3). Mushroom size variations could be explained by the fact that the texture and type of substrate as well the nutrients in chicken manure possibly affected the composition of the final mushroom growth substrate and qualities such as water holding capacity, degree of aeration; characteristics that consequently had an effect on mushroom size. It has also been recently reported by Kües (2000), Praphant (2005), Reyes et al. (2009) and Kurtzman, (2010) that variations of mushroom sizes in *C. cinereus* is a common phenomenon since fruiting body development process is very complex and the induction formation of the fruiting bodies is affected by complex interactions of environmental factors such as temperature, humidity, light, ventilation and nutrients in mushroom growth substrate. The luxuriance and rapidity of growth of a certain mushroom partly depend on the appropriate culture medium used in its cultivation, strain used, duration of cropping period, which consequently affect mushroom yield (Frimpong–Manso et al., 2010). In this study the highest mushroom yield of 381 g/kg moist substrate weight was obtained from sisal dust waste supplemented with 25% chicken

manure (Figure 4). However, the yield obtained in this study was higher than those obtained by other investigators working with *Coprinus* species. Mshandete and Cuff (2008) reported the yield of 238 g/kg moist substrate weight for *C. cinereus* cultivated on sisal wastes compost. On the other hand, Chaiyama et al. (2007) reported a mushroom yield range between 102-331 g/kg moist substrate weight from *Coprinus comatus* (O.F.Müll.) Gray cultivated on mixed pararubber sawdust, kapok waste and boiled sorghum. In view of the mushroom yield reported in the literature, the present study demonstrated an increase in mushroom yield by a factor range between 1.15-3.7. The reason for such increase is linked to addition of chicken manure (protein rich material) to sisal dust wastes substrate employed for growing *C. cinereus*, which lacked to other previous reported substrates formulations for *Coprinus* species.

The B.E. was determined as the ratio of fresh mushrooms harvested per dry substrate (both measured in kilograms) and expressed as a percentage. For example, a 100% BE would indicate that 1 kg of fresh mushrooms were harvested from each kilogram of dry substrate. The B.E. for *Coprinus* mushroom have been reported to be influenced by type of spawn carrier, type of technology employed, environmental conditions, type of substrates utilized either composted or non-composted, type and nutrient contents of supplements/additives used to enrich the substrates and variety of strains employed (Siwulski et al., 2001; Chen et al., 2007; Chaiyama et al., 2007; Reyes et al., 2009). In the present study the B.E. was significantly affected by the interaction between the three sisal waste substrates and chicken manure supplement at various rates. The highest B.E. of 119% for sisal leaves wastes and 112% from sisal dust were obtained at 5% and 25% chicken manure supplementation levels, respectively (Figure 5). Using rice straw supplemented with 2% urea or ammonium nitrate, 1% yeast, 1% sugar meal, 1% limestone and 0.1% magnesium sulphate, B.E. of *Coprinus comatus* (Muller : Fries) S.F. Gray has been found to be affected by cultivation technology. With bundle cultivation method B.E. was 67% while with shelf cultivation method B.E. was 75% (Praphant, 2005). On the other hand, Chen et al. (2007) reported B.E. of 41.1% and 55.5% for *C. cinereus* CC1 and CC2 strains, respectively grown on composted rice straw. Furthermore, Mshandete and Cuff (2008) reported highest B.E. of up to 68% for *C. cinereus* cultivated on sisal waste compost. Compared to above previously reported B.E. in literature on *Coprinus* mushrooms, the B.E. of 112% and 119% obtained in this study were higher by factor 1.5-2.9. The main reason for such higher B.E. was supplementation of chicken manure in basal non-composted solid sisal waste substrates. That implies that mushroom growers wishing to increase productivity of *C. cinereus* may do so by supplementing sisal waste substrates with only small quantities of chicken manure obtained from free-range chicken, which is readily available and cheap.

Conclusion

The results showed that chicken manure supplemented in non-composted sisal decortication wastes have overall positive effect on *C. cinereus* mushroom production. Chicken manure supplementation levels at 5% for sisal leaves waste and at 25% for sisal dust wastes were the best supplement levels for increased mushroom yield and productivity. Therefore chicken manure can be used to optimize the production of wild edible *C. cinereus* mushrooms especially at lower supplementation level of 5% for sisal leaves wastes and higher 25% level for sisal dusts wastes. In conclusion, chicken manure from free-range chicken could be recommended as a new supplement in Tanzania and elsewhere for cultivation of *C. cinereus* on non-composted sisal decortication wastes in particular sisal leaves and sisal dust wastes.

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