Effect of Beauty Salon Wastewater On Yield And Nutritional Value of *Abelmoshus esculentus* L. (Okra) and *Telfairia occidentalis* Hook, F. (Fluted pumpkin)

Abstract

The effect of beauty salon wastewater on the yield and nutritional quality of *Abelmoschus esculentus* L. *and* *Telfairia occidentalis* F. and was investigated. Plants were grown in perforated polythene bags filled with 3kg of top soil and irrigated with 0 (control), 25, 50, 75 and 100% of the wastewater. Plants were laid out in a completely randomized design (CRD) consisting of 5 treatments with 6 replicates per treatment. Results showed that the yield parameters of *Abelmoschus esculentus* including number of fruits/plant, fruit fresh weight and dry weight increased at 25-75% concentrations but decreased at highest concentration of 100% wastewater in comparison with the control. Similarly, the total biomass of *Telfairia occidentalis* and *Abelmoschus esculentus* increased at 25-75% concentrations of wastewater. The N, K, Ca and Na composition of the leaf of *T. occidentalis* and fruits of *A. esculentus* increased at all wastewater treatment levels. The percentage ash and protein increased in both plants treated with the wastewater. Lipid content increased while the fibre content decreased in *T. occidentalis* whereas in *A. esculentus* fibre content increased while the lipid content decreased in comparison to the control. Percentage carbohydrate increased in both plants treated with the wastewater. The use of beauty salon wastewater in irrigation of vegetables would not only reduce environmental pollution but also serve as an alternative source of fertilizer for vegetable production.

Keywords: Beauty Salon wastewater, *Telfairia occidentalis, Abelmoschus esculentus,* pollution, fertilizer.

1. INTRODUCTION

Scarcity of fresh water is a major challenge and concern worldwide. There are many reasons for this including low rainfall and extreme demand due to the combined effect of increased water use per capital and population growth. Population has increased at a rate faster than food production and will add up to 3 billion more people by the middle of the twenty-first century, mostly in poor and water - short countries (Jury *et al*., 2007). Rapid growth of urban population and industrialization results in generation of huge quantities of wastewater perennially. Wastewater rich in organic materials and plant nutrients is finding agricultural use as a cheap way of disposal. Application of wastewater to cropland and forested and is an attractive option for disposal because it can improve physical properties and nutrient contents of soils (Kiziloglu et al 2007). Waste water from different sources not only provides water but also contains considerable amount of organic matter and plant nutrients (N, P, K, Ca, S, Cu, Mn & Zn) and has been reported to increase the crop yield (Pathak et al. 1998, 1999, Siebe 1998, Ramana et al. 2001, Lubello et al. 2004, Nagajyothi et al. 2009, Nath et al. 2009). Thus, its use would help in water conservation, recycling nutrients (NPK) in wastewater, reducing direct fertilizer inputs and minimizing pollution loads to receiving water bodies (Hylander *et al.,* 2006;Thapliyal *et al.,* 2009;Vasudevan *et al.,* 2010).

However, apart from plant nutrients contained in wastewater, it may contain various potentially toxic elements and organic matters with highly harmful effects on human and animal health. Municipal wastewater contains relatively high amounts of sodium, which can be accumulated in the soil during irrigation with this wastewater and display toxic effects on the plants. If this wastewater is not disinfected or treated in stabilization ponds, it is highly contaminated with microorganisms. Therefore, the utilization of municipal wastewater for the irrigation of crops is associated with a number of risks. Very serious risks are those of crop yields reduction, crops contamination with pathogens and intestinal helminthes (Zavadil, 2009).

Vegetables play important role in meeting the food requirements of people world-wide, because they are important source of various essential components i.e. minerals, dietary fibers and vitamins (Ogle *et al.,* 2001). They are also potential sources of essential nutrients, constitutes functional food components by providing protein, iron and calcium which have noticeable health effects (Arai, 2002). The continuous demand for vegetables has increased the need to cultivate these crops all year round. This in effect leads to the dependence on wastewater during the dry seasons or during periods of drought. Also, due to the light water requirement of some crops, the use of wastewater to supplement the freshwater, if any, becomes inevitable

2. Materials and Methods

2.1 Experimental Location

The experiment was conducted in the screen house of the Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba Akoko, Ondo State, Nigeria with latitude 7^0 37^iN and longitude $5^0$44E.

2.2 Planting Materials

Matured seeds of *Abelmoschus esculentus* were obtained from the Premier Seed Company Ibadan, Oyo State, Nigeria, while that of *Telfairia occidentalis* were obtained from a local market at Oka-Akoko, Ondo State, Nigeria.

2.3 Experimental Set up

Top soil used for the experiment was collected from the experimental farm of Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba Akoko. The soil was air-dried and sieved through to remove stones. The beauty salon wastewater was collected from a septic wastewater tank from a beauty salon in Akungba Akoko, Ondo State. Concentrations of 25, 50, 75, and 100% of the wastewater were prepared in a plastic keg just before each treatment by dilution with tap water to make the desired concentrations. Four viable seeds of *Abelmoschus esculentus* and three viable seeds of *Telfairia occidentalis* were sown in perforated polythene bags containing 3kg of top soil. Seedlings were allowed to establish for three weeks and thinned to one seedling per pot. Plants were irrigated with the wastewater at 0 (control), 25%, 50%,75% and 100% concentrations. Each pot was treated with 250mL (volume enough to keep the soil moist) 2 times in a week; thus each pot received 500mL of wastewater treatment per week. The treatment lasted for 8 weeks. The experiment was carried out from July to October, 2016. Pots were laid in a completely randomized design, with 6 replicates per treatments. The experiment ended in October 2016 by harvesting the fruits of *Abelmoschus esculentus* with the seeds and leaves of *Telfairia occidentalis.* Their fresh weight was determined after which they were oven-dried at 80^{o}C for the dry weight measurement.

2.4 Nutritional and Phytochemical analysis

Dried seeds of *Abelmoschus esculentus* and dried leaves of *Telfairia occidentalis* were milled for chemical analyses. Total N was determined by micro–Kjeldahl method. For P, K, Ca and Mg, samples (0.5 g) were ashed, dissolved in 10% HCl and diluted to 50 ml. P was determined using Vanado molybdate colourimetry. Ca and Mg were determined by EDTA titration, while Na and K was by flame photometry. Seeds and leaf were also assayed for proximate compositions: crude protein, fat and carbohydrate, crude fiber and total ash following the method of AOAC.

2.5 Statistical analysis

The data obtained were subjected to one-way analysis of variance (ANOVA) and means were separated with Tukey HSD Multiple Range tests at 5% level of probability using SPSS 21.0.

3. RESULTS

Table 1. shows the effect of beauty salon wastewater on the yield of *Abelmoschus esculentus.* Beauty salon wastewater at 25-75% concentrations increased the yield of *Abelmoschus esculentus.* But the yield reduced at 100% concentration in comparison with the control. Plants irrigated with 75% concentration of the wastewater yielded an average of 4.00 fruits per plant compared to average of 3.85 fruits per plant in control and average of 3.67 fruits per plant in higher concentration of 100% of the wastewater. Similarly, the fruits fresh and dry weight increased at 75% concentration and reduced at 100% concentration of the wastewater in comparison with the control.

Table 1.

Yield of *Abelmoschus esculentus* (Okra) grown in soil irrigated with water containing different proportions of beauty salon wastewater under screen house condition

Yield parameters	Quantity of beauty salon wastewater applied (%)				
	0	25	50	75	100
Number of fruits/plant	3.85^a	4.00^a	3.87^a	4.00^a	3.67^a
Fruit fresh weight/plant (g)	31.64^a	36.41^a	34.04^a	41.48^a	31.56^a
Fruit dry weight/plant (g)	4.31^a	4.76^a	4.66^a	6.36^a	3.81^a

Each value is a mean± S.E of 6 replicates. For each value, means with the same letter(s) in superscript on the same row are not significantly different at $P \geq 0.05$ (Tukey HSD test)

Plant biomass were compared. Table 2. Shows the result of the effect of beauty salon wastewater on the root dry mass, shoot dry mass and total biomass of the two vegetables. Increase in biomass was observed at 25-75% concentrations in comparison with the control. Fig 1. Shows highest increase in the biomass of *Abelmoschus esculentus* at 50% concentration of wastewater. Fig 2. Shows that 25% concentration had the highest increase in the total biomass of *Telfairia occidentalis.*

Table 2.

Dry mass, Root: shoot ratio and Relative growth rate of *Abelmoschus esculentus* and *Telfairia occidentalis* grown in soil irrigated with beauty salon wastewater under screen house condition

	Vegetable species	**Quantity of beauty salon wastewater applied (%)**				
		0	**25**	**50**	**75**	**100**
Root dry mass (g)	***Telfairia occidentalis***	2.92^{a}	4.17^{a}	3.52^{a}	5.68^{a}	2.69^{a}
	Abelmoschus esculentus	2.49^{ab}	3.29^{c}	2.70^{abc}	2.88^{bc}	2.03^{a}
Shoot dry mass (g)	***Telfairia occidentalis***	4.3^{b}	5.06^{a}	5.75^{a}	6.17^{a}	6.63^{a}
	Abelmoschus esculentus	3.3^{bc}	4.13^{b}	5.86^{b}	7.86^{a}	7.73^{a}
Total biomass (g)	***Telfairia occidentalis***	6.43^{b}	7.29^{ab}	8.08^{ab}	8.53^{a}	9.19^{a}
	Abelmoschus esculentus	5.8^{c}	7.03^{ab}	8.89^{ab}	10.99^{a}	11.59^{a}
Root: shoot ratio	***Telfairia occidentalis***	0.50^{ab}	0.44^{b}	0.41^{b}	0.38^{b}	0.39^{b}
	Abelmoschus esculentus	0.76^{b}	0.70^{b}	0.52^{c}	0.4^{c}	0.50^{c}

Each value is a mean± S.E of 6 replicates. For each value, means with the same letter(s) in superscript on the same row are not significantly different at $P \geq 0.05$ (Tukey HSD test)

FIGURE 1

Effect of beauty salon wastewater on biomass of *Abelmoschus esculentus.*

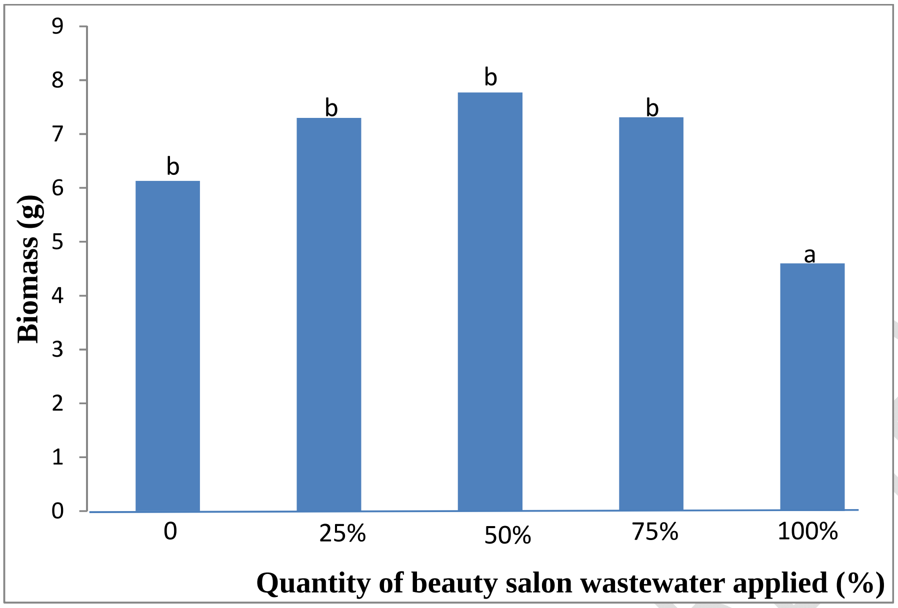
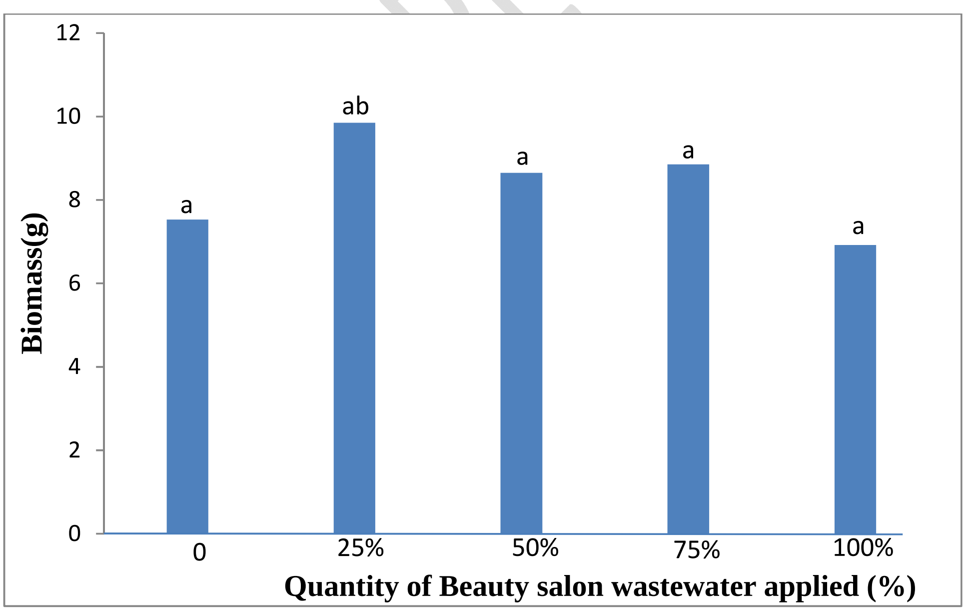


FIGURE 2

Effect of beauty salon wastewater on the biomass of *Telfairia occidentalis.*



Beauty salon wastewater at all treatment levels(25-100%) caused an increase in the nutrient composition of the fruits of *Abelmoschus esculentus* and leaves of *Telfairia occidentalis* when compared with the control. N, K, Ca and Na composition of the two vegetables increased in comparison with the control. The result also shows increase in the percentage ash and protein content of the plants. Lipid content increased while the fibre content decreased in *T. occidentalis* whereas in *A. esculentus* fibre content increased while the lipid content decreased in comparison to the control.

Figure 3:

Nutritional and proximate composition of leaves produced by *Telfairia occidentalis* (Fluted pumpkin)grown in soil irrigated with water containing different proportions of beauty salon wastewater under screen house condition

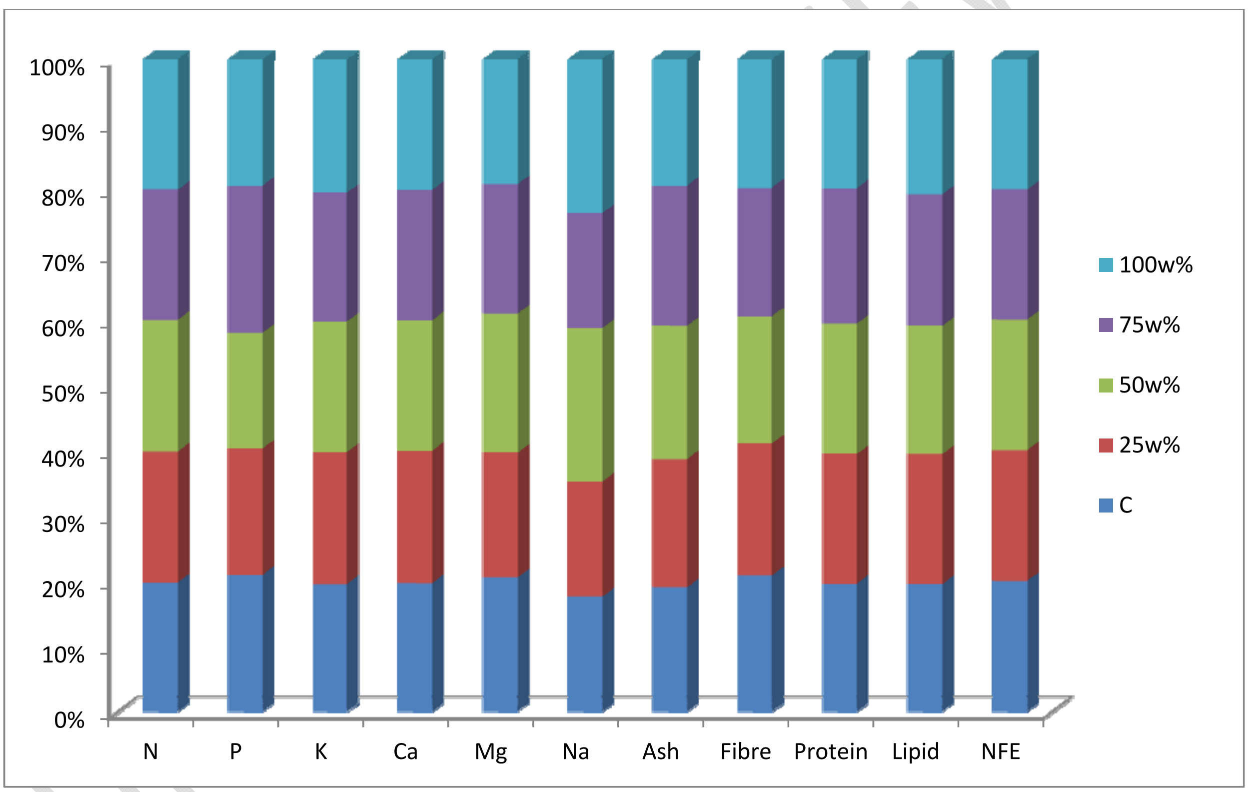
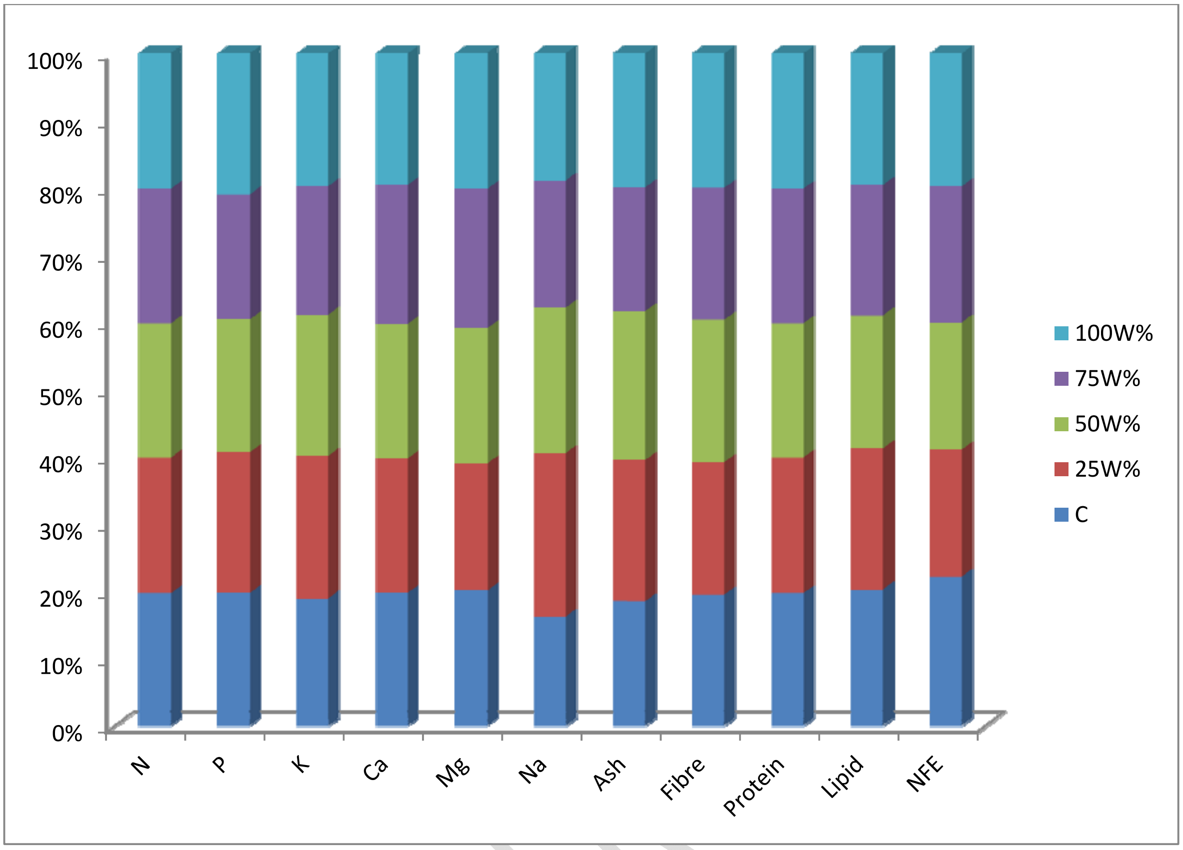


Figure 4.

Nutritional and proximate composition of fruits produced by *Abelmoschus esculentus* (Okra) grown in soil irrigated with water containing different proportions of beaauty salon wastewater under screen house condition



4. DISCUSSION.

The effect of wastewater on environment has been demonstrated and discussed extensively by many authors. Results of this experiment showed the effect of beauty salon wastewater on the yield and nutritional value of *Telfairia occidentalis* (Fluted Pumpkin) and *Abelmoschus esculentus* (Okra).

Table shows that plant irrigated with 25-75% concentrations of beauty salon wastewater had higher yield than the control. This concur with the previous finding of Kiziloglu *et al.* (2008) that wastewater irrigation treatment increased the availability of N, P, K, Ca, Mg, Na, Fe, Zn and Cu to plant which led to increase of red cabbage yields. Similarly, *Gossypium spp* yield was improved by using diluted municipal wastewater with groundwater at 50:50 mixtures when compared to groundwater alone from wells in Arizona (Day *et al.*, 1981). Day *et al.* (1974) also compared the effect of irrigation with wastewater and pump water on wheat. They concluded that wastewater irrigation produced taller plants, heavier seeds and higher grain yields than pump water. Wastewater has the potential to increase plant yield than the control. Similar results were also recorded by Juwarkar *et al.* (1990) in *Arachis hypogea*.

Higher concentration of beauty salon wastewater decreased the dry weight of the root, stem and leaf of *A. esculentus* and *T. occidentalis.* The reduction in the dry weight might be due to the poor growth of the seedlings under effluent stress. The plant biomass of the two vegetables increased at 25-75% treatment levels of the wastewater. It was reported by Misra *et al*. (2009) that *Solanum lycoperscum* irrigated with greywater obtained higher nutrient uptake and biomass at the flowering stage when compared to tap water.

The proximate analysis of *Telfairia occidentalis* shows that Beauty salon wastewater increased leaf N, K, and Ca while other nutrients were not affected. Similarly, percentage ash, lipid and protein increased in the leaves of beauty salon waste treated plants (Figure 3). This finding is in accordance with Babyshakila *et al.*(2009) that biochemical content of lipid, ash and protein increased at 50 and 75% concentrations of wastewater in the leaf samples of *Vigna radiate*. The Fibre and carbohydrate contents decreased relative to the control. The proximate analysis of *Abelmoschus esculentus* shows that Beauty salon wastewater increased the composition of N, K, Ca and Na at all treatment levels in the fruits of *Abelmoschus esculentus* in comparison to the control (Figure 4). Al- Jaloud *et al.*(1995) reported elevated concentration of N, Ca, Mg, and Na in leaves of *Sorghum* when the crop was irrigated with wastewater. Moreover, Vazquez-Montiel *etal.*(1996) found that irrigation of maize (*Zea mays*. L.) with treated wastewater resulted in increase in N, P, K and Mg concentration in leaves. Fonseca *et al.*(2005a) also obtained similar results in a greenhouse experiment with maize. Also, there was an increase in the percentage ash, fibre and protein at all treatment levels whereas the lipid and carbohydrate contents decreased in comparison to the control.

CONCLUSION

The research has revealed that beauty salon wastewater improved seedling growth and yield of *A. esculentus* and *T. occidentals* when diluted with water at 25-75% while the undiluted one reduced plant growth and yield. Besides, beauty salon wastewater did not have negative effect on the nutritional quality. Consequently, beauty salon wastewater can serve as an alternative liquid fertilizer in the production of *A. esculentus* and *T. occidentalis* if applied to soil at levels not above 75% dilution.

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