Dry rendering is a bio safe method of utilization of dead poultry birds where the end products are carcass meal and Rendered Chicken Oil (RCO). Conversion of RCO into biodiesel may open new vistas for generating wealth from waste for poultry farmer besides controlling the major havoc of environmental pollution caused by the unscientific disposal of dead carcass. Therefore, a study was carried out to assess the utilization of dead poultry birds for the production of biodiesel.

The whole dead poultry carcass (1.25kg body weight) had 14.55 ± 0.17% fat and the fat content of greaves i.e. whole carcass, cooked and dried in the rendering process was 14.49 ± 0.38%.

In the dry batch rendering trials, the mean overall fat recovery was 24.46 ± 1.19, 26.78 ± 3.14 and 22.42 ± 2.32 per cent and the overall fat yield was 3.52 ±1.72, 3.84 ± 0.44 and 3.22 ± 0.33 per cent of the carcass weight in T1, T2 and T3, respectively.

Key words: Dead bird disposal; Dry rendering; Rendered Chicken Oil; Biodiesel

Solvent extraction of fat could recover 96.10 ± 0.14% of fat from ‘greaves’ and the overall solvent recovery was 88.98 ± 0.32% which was significantly higher than mechanical centrifugation method.

Among the physico-chemical properties of the RCO, moisture content ranged from 0.61% (T2) to 1.09% (T1) and the mean specific gravity was 0.91 at 30 °C. The FFA values of RCO obtained from T3 rendering regimen was significantly \( p < 0.05 \) higher than the FFA values of T2 and T1. The mean acid value, iodine number, peroxide value, saponification value and unsaponifiable matter present in RCO showed no significant difference. The fuel properties of RCO viz. kinematic viscosity, flash point, fire point, ash content, cloud point and the pour point were analysed for the three treatments.

The overall fuel properties of RCO revealed that the RCO had viscosities eight times greater than that of diesel fuel, low volatility as revealed by high flash and fire points and poor cold flow properties as indicated by the high cloud and pour points. The calorific value was also less than that of diesel fuel (42.5 MJ/kg). Therefore, it cannot be used directly as a fuel in the compression ignition engines.
Acid catalysed esterification of FFA with 30:1 methanol molar ratio, 10% H2SO4 concentration at 60 °C for a reaction period for 120 minutes, could significantly (p <0.01) reduce the FFA value of RCO to a minimum value of 0.70%. Base catalysed transesterification of triglycerides with methanol molar ratio of 6:1, NaOH catalyst 0.5% to triglycerides at 60 °C for 90 minutes reaction period produced the maximum biodiesel yield of 97.62% and lowest glycerol yield of 16.96%.

Thus the two step processing reaction (acid catalysed esterification of FFA followed by base catalysed transesterification of triglycerides) could effectively convert RCO to biodiesel with a high biodiesel yield of 97.62%. The specific gravity of neat biodiesel (B100) was 0.876 ± 0.02, B20 was 0.835 ± 0.01 and that of commercial diesel was 0.826. The mean acid number was 0.46 for B100 and 0.42 mg KOH/g for B20. The mean iodine number of B100 was 60.83 ± 0.03 and that of B20 was 60.57 ± 0.22 gI2/100g. The gas chromatographic examination of the biodiesel revealed that there was a change in the fatty acid profile of RCO during the transesterification process and the fatty acid composition of biodiesel consisted of palmitic acid (29.23%) followed by oleic acid (27.32 %), stearic acid (25.45 %), linoleic acid (11.97 %) and palmitoleic (3.4%). The observed total glycerol content of biodiesels was 0.09%. There was no free glycerol in the RCO biodiesel and the methyl ester conversion calculated based on the total glycerol in RCO and in biodiesel was 99.35%. Among the fuel properties of the RCO biodiesel, kinematic viscosity at 40 °C was 5.83 ± 0.05 cST for B100 and that of B20 was 4.74 ± 0.03 cST, against the low viscosity of 4.43 ± 0.04 cST of commercial diesel. The flash point of B100, B20 and B00 (diesel) were 172.16 ± 0.16, 52.5 ± 0.28 and 50.26 ± 0.37, respectively. The mean flash point of RCO which was 195.17 °C was reduced to 172.16 °C in biodiesel (B100) by the process of transesterification. The fire point of B100, B20 was 183 °C, and 65.56 ± 0.06 °C while that of B00 (diesel) was 60 °C. The mean fire point of RCO (208.32 °C) was reduced to 183 °C in the corresponding biodiesel by the process of transesterification. The gross calorific value of B100 was 38.71 ± 0.10 MJ/kg, B20 was 39.46 ± 0.20 MJ/kg and that of B00 was 42.42 MJ/kg. The cloud point of B100 was 5.3 ± 0.05 °C and that of B20 was -0.9 °C. The pour point of B100 was 1.8 ± 0.05 °C and that of B20 was -15 ± 0.16 °C. B100 had a mass carbon residue of 0.13 ± 0.03%, B20 had 0.21 ± 0.003% mass carbon residue and the same for commercial diesel was 0.24 ± 0.03% mass. The BIS specification of carbon residue for biodiesel was 0.3% mass maximum. The results revealed that the biodiesel conformed to the BIS specification and compared to biodiesel and biodiesel blends, the commercial diesel had more carbon residue of 0.24%, compared to commercial diesel (B00) which had a cetane number of 54.4, biodiesel blend B20 had a cetane number of 64.8 and B100 had a high cetane number of 72.5. This indicated that B100 would have shorter ignition delay leading to high engine efficiency and subsequently reduced exhaust emissions.
Overall, the biodiesel prepared from RCO had good fuel properties and conformed to the BIS specification for biodiesel. The fuel properties of biodiesel blend B20 was more close to that of commercial diesel except for carbon residue which revealed that B20 and B100 would produce less smoke compared to commercial diesel.

The cost of 1 litre of biodiesel produced by mechanical centrifugation method after dry batch rendering was ` 35.68 and the cost of biodiesel produced by solvent extraction method was ` 22.00/L. In an engine trial, the total fuel consumption and brake specific fuel consumption were low compared to commercial diesel at all tested loads, while mechanical efficiency and brake thermal efficiency were high compared to commercial diesel at all tested loads. At the maximum brake power of 58 kW, the smoke opacity of B20 was 47.14% less than that of diesel. The exhaust gas temperature was lower in the entire range of loads, while using B20.

The results vividly exhibited the fact that the fuel properties of RCO B20 were comparable to that of commercial diesel, following the same trends in the engine parameters tested. Thus the blending of commercial diesel with 20% RCO biodiesel leads to less engine wear, a quieter engine and better fuel economy. The better lubricating qualities of RCO B20 prevented over heating of engine, which prolongs the engine life. The blending of biodiesel at 20% to commercial diesel can reduce the import of costly crude oil and simultaneously, substantially reduce the engine emissions as proved by significantly lower smoke levels, thus protecting our mother earth from the evils of pollution.