3.3 Proximate Composition of Seed Cake

Table 4 illustrates the proximate composition of the seed cake. The lipid percentage ranged from 41 .6% to 46.3% with a mean percentage of 44.2%; while the percentage of crude protein ranged from 11.81 to 12.43% with a mean percentage of 12.11%. However, the ash content of the seed cake ranged from 5.9 to 6.5% with a mean percentage of 6.5%. The results also revealed that the percentage of moisture content ranged from 2.94 to 3.03% a mean percentage of 2.99% and fiber content ranged from 9.50 to 10.50% with a mean value of 10.16%. The percentage of carbohydrate ranged from 24.29-30.57%, with a mean percentage of 27.15%

Table 4: Proximate Composition of the Seed Cake of Jatropha curcas in Gusau, Zamfara State Nigeria, 2007

S/No.	Parameters	Replicates			Mean	SE
		1	2	3		
1.	Lipid	44.8	46.3	41.6	44.2	±0.322
2.	Crude protein	12.10	11.81	12.43	12.11	±0.0173
3.	Ash content	6.50	7.10	5.90	6.50	±0.062
4.	Moisture	3.00	2.94	3.03	2.99	±0.0111
5.	Fiber	10.00	10.50	9.50	10.16	±0.005
6.	Carbohydrate	26.60	24.29	30.57	27.15	±0.084

3.4 Proximate Analysis of Mineral Content

The outcome from analysis of the mineral content is presented in Table 5. The percentage of magnesium ranged from 0.22 to 0.23%. The highest percentage was in the third trial (90.23%), followed by the first and second trial (0.22%) each. It could be deduced from the analysis that the mean percentage is 0.22 ± 0.02 percentage of sodium ranged from 0.000645 to 0.00060. Third trial had the highest percentage (0.00666%), followed by the first trial (0.006650%), and the least in the second trial (0.000645). The percentage mean value is 0.060652 ± 0.012.

However, the highest percentage of potassium was in the first trial 0.03075%), followed by second trial (0.03063%) The mean percentage value was 0.0308 + 0.005%

Calcium ranged from 0.043 to 0.045%; the highest was in the second trial (0.048%) followed by the first trial (0.045%) and the least percentage in the third trial (0.043%). The mean percentage value was 0 0450 ÷ 0.007%.

Table 5: Proximate Analysis of the Mineral Content of Seed Cake of *Jatropha curcas* in Gusau, Zamfara State Nigeria, 2007

S/No.	Parameters (%)	Replicates			Mean	SE
		1	2	3		
1.	Mg	0.22	0.22	0.23	0.22	±0.02
2.	Na	0.000560	0.000645	0.000660	0.000652	±0.0012
3.	K	0.000560	0.3062	0.0310	0.0308	±0.005
4.	Ca	0.045	0.043	0.043	0.045	±0.007

4. Discussion

The results obtained from various aspects of this study indicated that Barbados nut, *Jatropha curcas* is an oil yielding plant. Seed collection and weighing carried out have shown that much number of seeds per fruit pod and weight of the plant have a great potential to produce vigorously within the shortest possible time. This might be due to the fact that, the weight of the seed is an indication that it contains adequate amount of food reserve (endosperm) to enable it sustained the embryo during germination process, and this may in turn influence the amount of oil extraction from the plant. The report however, indicated that *J. curcas* plants can establish easily irrespective of the seed source. According to [16], the use of physic nut seeds for seedlings should be derived from the fruits, which skin is yellow up to blackish yellow in color, because they have high percentages of viability and vigority, i.e. 89 and 81%, respectively.

The high percentage of seed viability and germinability (65.7 and 98.33%) was reported in this research as coupled with the species ability to regenerate through stem cuttings have probably helped to ensure its abundance in the study area. This might be due to favorable temperature, humidity, seed drying or storage conditions and seed oil content among others. Between 40% - 60% moisture content, metabolic activities increase and seed germination is triggered off [17]. [18] documented that temperature, water, oxygen and light are important external conditions necessary for seed germination. [19] also viewed seed quality as a multiple criterion that encompasses several important seed attributes: genetic and chemical composition, physical condition, germination and vigor, seed size, seed moisture content, drying and seed physical appearance.

It was reported from this research that the soil sampled out, including the sandy fraction tends to decreases with depth, while silt and clay in the soil samples determine its textural class as sandy loam. The presence of sandy loam in the study area may be the reason why *Jatropha curcas* thrived well. However, high percentage (0.88%) of organic matter content in the surface soil may be attributed to the decomposed leaves of the plant which tails on the soil surface. These contributed a lot in the fertility of the soil and stimulate growth of microbes which in turn improve the soil structure. The moisture content of the soil sample was higher in the samples from the surface (16.78%), followed by soils from 15cm and 30cm depths (12.48 and 10.65%) respectively. This variation in moisture content may be attributed to the presence of organic matter and fibers in the soil surface which helped in retaining the moisture. This may eventually be utilized by the plant for growth and growth and development. The most frequently tested seed quality parameters according to [20] rules and standards are: physical purity, germination percentage, analytical purity, vigor, and seed health. Among these parameters, seed health testing currently suffers limited application, but germination potential is perhaps the most important quality parameter which is often used to determine sowing rates, time of sowing or whether the seed can be stored [21]; [22]. [23] contended that sowing of high quality seed in fermented loam and sandy-loam soils is essential for improving crop yields and increasing food production. Thus, assessing seed quality before planting is most important for famers and plant geneticists These reports are in line with the work of [24] who noticed that seed germination in *Jatropha curcas* was found to be high ranging between 68% and 90% but

these values were lower than those obtained before the seeds were dried (90% and 97%).

The variation in the mean pH value i.e. 6.70 and 5.56 to 5.67 for the three soil samples at different depths respectively showed that *Jatropha curcas* decreases the soil pH from slightly acidic 6.70 (surface soil) to moderately acidic 5.65 and 5.67 respectively (down soil). [25] reported that elements such as nitrogen, phosphorus, potassium calcium and magnesium are generally more available in pH range of 6.5 - 7.5. The acidity of the soil in the study area may be attributed to the presence of *Jatropha curcas*. But, [26] reported that *Jatropha curcas* grows best on well drained soils (pref pH 6-9) with good aeration and well adapted to marginal soils with low nutrient content.

However, it has been established in this study that the density of the soil samples appeared to be higher on the surface (0.89%) and moisture decreases down ward 0.85 and 0.82% respectively. The higher density on the surface may be due to the presence of *Jatropha curcas* plant.

The mean percentage of exchangeable cat ion ranged from 1.03 to 8.91; this greater variation may be due to influence of *Jatropha curcas* plant. The results presented in this regard illustrated the percentage content of magnesium, nitrogen and calcium which is generally greater than sodium and potassium. This showed that the mentioned nutrients contributed a lot in the growth and development of the plant. From the results obtained in oil extraction process, the first (1^{st}) trial yielded 2.5L, followed by the 2^{nd} and 3^{rd} trials. The variation in the amount of oil extracted in the three trials may be attributed to the size of the seeds used. If planted in hedges, the reported productivity of *Jatropha* is from 0.8 kg to 1.0 kg of seed per meter of live fence. The seed production is around 3.5 tons / hectare but, seed yields under cultivation can range from 1,500 to 2,000 kilograms per hectare, corresponding to extractable oil yields of 540 to 680 liters per hectare [27].

Jatropha curcas is a drought resistant tropical tree and the oil from its seeds has been found useful for medicinal and veterinary purposes, as insecticide, for soap production and as a fuel substitute [28].

However, the results obtained from proximate analysis of the seedcake of *Jatropha curcas* indicated that the percentage of lipid ranged from 41.6 to 46.3% with the mean percentage of 44.2%. The high percentage of lipids showed that the plant *Jatropha curcas* have the potential of yielding a consideration amount of oil. [29] reported the composition of *Jatropha curcas* where seeds contained 5.12% moisture, 48.5% crude oil, 25% crude proteins, 7.78% carbohydrate by difference, 9.4% crude fiber and 4.2% ash. According to [30], the mature seed yields 36–64% oil.

The value of crude protein obtained (12.11%) showed that the cake may be a very good source of protein for animals. This is true in the sense that literature cited revealed that the seed cake is poisonous but it is treated, it can be consumed by animals, In terms of ash content, the results of 6.5 ± 0.062 gives us a highlight as to the amount of inorganic materials present in the soil samples analyzed. It should be noted that high percentage of ash content means high content of minerals, while low content of minerals is indicated by the low percentage of ash content [31]. Most importantly, ash contains the minerals calcium magnesium, phosphorus and potassium. This may be the reason why the seedcakes are very important sources of fertilizer because the minerals discovered in this study are very important for the growth and development of the plants. [32] reported a 47.25% yield by weight of the seed. Variation in oil yield may be due to the differences in variety of plant, cultivation climate, ripening stage, the harvesting time of the seeds and the extraction method used. Among the minerals reported in this aspect of research, it is of interest to note that the most prevalent mineral element in *Jatropha curcas* seeds is Potassium which is high as 518.35 ± 0.44 mg/100g dry matter. Potassium is an essential nutrient and has an important role in the synthesis of amino acids and proteins [33]. But, [34] reported that Magnesium (483.30 ± 0.02mg/100 g dry matter) plays a significant role in photosynthesis, carbohydrate metabolism, nucleic acids and binding agents of cell walls in *Jatropha curcas*.
The third trial yielded the highest moisture content, followed by the first and the second trials (3.00 and 2.94%) respectively. The amount of moisture obtained from the seed cake may be attributed to the oil extracted leaving a minute amount of moisture. [23] reported that seed oil content of *Jatropha curcas* seed was significantly affected ($p > 0.05$) when dried to 10% and 8% moisture levels, and the seed oil content remained high (42% and 55%) and higher than those observed by [35] who reported a range 73 between 36-40%.

The large amount of carbohydrates (27.15 ± 0.084) reported in this research showed that, if the cakes will be treated, it might be a very good source of energy for animals and man. The mineral contents of the seed cake revealed that magnesium has the highest mean percentage value 0.22 ± 0.02, followed by calcium and potassium 0.0450 ± 0.007 and 0.0308 ± 0.005 and the least percent in sodium 0.000652 ± 0.012. These minerals may potentially be a very good source of oil and calorific value if supplied in an appreciable amount; and may also contribute immensely to the growth of some oily-seeded plants in some Arid and Semi-Arid zones. [36] reported the moisture content of wild melon (*Citrillus ecirrhosis*) seeds to be 3.73 ± 0.25% in dry weight (DW) composition and added that, oil yield for the decorticated seeds as 50.67 ± 0.76%, as compared to Physic nut (62%) and sesame (54.0%) seeds.

5. Conclusion

From the research and analysis carried out, there is evidence that Barbados nut, *Jatropha curcas* is economically important because, it can yield a considerable amount of oil which may be used as a substitute for fuel and other valuable uses, such as soap making, source of nutrients, source of medicine, and live fence. The plant also produced seeds incorporated with nutrients along with biochemical composition that in turn yielded reasonable amount of oil for commercial purposes.

During the collection of seeds in this research, some seeds were found to be infested with golden flea (*Podagrica* Spp.,) in this cause the seeds lack endosperm which assist embryo

for germination, weightless when measured. They also tend to float on the surface of water when immersed and as such germinability test could not be carried out on them. It is recommended that survey and analysis be carried out by subsequent researchers to investigate the pest and diseases attacking the yield of J. *curcas* plants in the study areas.

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