COMPARISON OF SOME YIELD VARIABLES IN COCONUT FRUIT PRODUCTION

Queeneth Victory NWANKWO

AGR1900209

DEPARTMENT OF CROP SCIENCE

FACULTY OF AGRICULTURE

UNIVERSITY OF BENIN

BENIN CITY, NIGERIA

JULY, 2025

COMPARISON OF SOME YIELD VARIABLES IN COCONUT FRUIT PRODUCTION

Queeneth Victory NWANKWO

AGR1900209

FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, BENIN CITY, NIGERIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF AGRICULTURE DEGREE (B. AGRIC) IN CROP SCIENCE

JULY, 2025

CERTIFICATION

This is to certify that this research was carried out by Queeneth Victory NWANKWO of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City, Edo State, Nigeria.

PROF S.A. OGEDEGBE **Date**
Project supervisor

PROF EGHOSA OSAGIE **Date**
Co Project supervisor

PROF S.U. EWANSIHA **Date**
Head of Department

DEDICATION

I dedicate this project work to God Almighty who has been the source of my strength, finance, wisdom, understanding and inspiration.

ACKNOWLEDGEMENTS

I would like to extend my gratitude and heartfelt obligation towards my mum Mrs. Philo Ifada, my uncle Mr. lekan and my best friend Mr. Ama Onuoha, without their active guidance, help, cooperation and encouragement I would not have come this far.

My heart felt gratitude goes to my supervisor Prof S.A. Ogedegbe for his guidance and contribution to the success of this work. I also extend my appreciation to all the lecturers in the department of Crop Science, Prof S.U. Ewansiha, Prof K.E Law Ogbomo, Prof T.O. Emede, Mr. J.O Osagie, for their pivotal role in making this research work a reality.

A special appreciation from me also goes to the Dean of Agriculture, Prof Christopher O. Emokaro.

Finally, I wish to appreciate my colleagues for their support and encouragement. God bless you all.

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

A study was conducted to compare yield of some fruit variables of Ghana and Nigeria coconuts. The main objective was to compare coconut oil yield between Nigeria and Ghana coconut types. The experiment also evaluated five key variables namely, weight of coconut, water, shell, copra and oil content. Standard pressing method was applied and, in the process, shell and copra were extracted, blended, sieved before oil was finally extracted through heating. The data collected were analyzed using T-test at 5% level of significance. The results shows that coconut and shell were significantly different with Nigeria coconut producing higher values of 557g and 400g in copra and shell variables respectively. The other variables did not differ between the coconut types. Furthermore, Nigerian coconut had a higher value of crude protein and oil whereas Ghana coconut surpassed Nigeria coconut in all other variables. In conclusion, Nigeria coconut was better ($p <\_ 0.05$) than Ghana coconut, shell and copra variables whereas all other variables were similar.

CHAPTER ONE

INTRODUCTION

The coconut tree (*Cocos nucifera)* belongs to palm tree family (*Arecaceae*). They are ubiquitous in coastal tropical regions and are a cultural icon of the tropics.

The term “coconut” can refer to the whole palm, seed or drupe. Coconut originated in the India-Indonesia region.

Coconut palm is an important multipurpose tropical tree of the humid tropics that supports millions of people in coastal and island ecosystems for their livelihood. It has been traditionally used for its oil, and varied products like the copra, water, husk, fiber and leaves.

Coconut oil is an edible oil derived from the kernel or milk of the coconut palm fruit. Coconut oil is a white solid fat below 25°C and a clear thin liquid oil at higher temperatures. Coconut oil can be used as food oil and in industrial applications for cosmetics, detergent production, shampoos, synthetic rubber and glycerin. Coconut oil contains trace amounts of free fatty acids (about 0.03% by mass). It contains 99% fat, composed mainly of saturated fats (82%), coconut oil supplies 890 calories in a 100g sample.

Initially, coconut oil was classified along with saturated fatty acid food items and criticized for its negative impact on health. However, research studies have shown that coconut oil is a rich source of medium-chain fatty acids. Despite all the health benefits, consumption of coconut oil is still underrated due to lack of supportive scientific evidence and comparatively low level of production.

As an oil recently introduced to western countries, it is often used to bake and sometimes used in the production of popcorn. Some other culinary uses include replacing solid fats produced through hydrogenation in baked goods. Hydrogenated or partially hydrogenated coconut oil is often used in non-dairy creamers and snack foods. In frying, the smoke point of coconut oil is 227°C.

1.1 Objective of the study

The Objective of this study was to evaluate the difference between Nigeria coconut and Ghana coconut in respect to five variables: weight, shell, water, copra and oil.

CHAPTER TWO

LITERATURE REVIEW

2.1 TYPES OF COCONUT

There are two types of coconuts; the dwarf coconut and tall coconut varieties

DWARF VARIETIES

1. Chowghat orange dwarf coconut

This is an early flowering variety, taking between 3-4 years to begin flowering and subsequently beating fruits. It attains a height of 16 feet tall when mature and requires a well-drained soil for optimum growth. The coconuts produced by this tree are round with orange type skin. They have a subtle yet sweet tasting water and a high content of copra. They have a life span of 50 years, producing about 65 nuts per year when they attain maturity. This palm tree is self-pollinating, sensitive to high wind and droughts and requires warm temperatures ideally above 70°F.

2. Malayan dwarf coconut

This palm is the most grown dwarf coconut tree across the world with a height of 30-60 feet tall when mature and is a drought tolerant variety. It was initially produced in Malaysia in the 1800s as a result of hybridization. It blooms in the spring with small and

inconspicuous white flowers. Following this, the tree bears oval green fruits but as it ripens it develops to a different color depending on the cultivar. The Malayan yellow dwarf coconut trees bear fruits that are pale yellow, whereas the Malayan green dwarf coconut trees produce fruits that remain green, and also has another cultivar called the golden Malayan coconut that are golden bronze in color when ripe.

3. Macapuno coconut

This coconut has not water, but instead is filled with a soft flesh that resembles a jelly. Due to their rarity has become an expensive delicacy in Asia. They have a higher content of sugar compared to other regular coconuts and therefore used for deserts. It was first discovered in the Phillipines in 1931 and is commonly called “coconut sport”.

4. Fiji Dwarf

This coconut cultivar, is most resistant to lethal yellowing disease. It is called a dwarf tree because it bears fruits several years just into its life while it is still short and therefore is able to be harvested by hand without the use of a ladder. As the tree ages, it continues to grow at the rate of 1 foot per year and can attain a height of 25 feet when fully mature. The Fiji tree is tolerant to wind, poor soil, and rainfall.

5. King coconut

They are native to Sri Lanka. The fruits produced are orange in color with smooth and shiny skin and has a high content of sugar. It requires a well-drained soil for optimum growth and attains a height of 30 feet tall when mature.

TALL VARIETIES

1. East coast tall coconut

This is a widely cultivated coconut cultivar. It takes about 6-8 years to start bearing fruits with about 70 coconuts annually. It is tolerant to a wide range of soils including loamy, sandy and poor soils. It does not do well in water logged soils, but will survive in dry soils where annual rainfall is low even though the fruit production will be compromised. It attains a height of 90 feet tall when mature.

2. West coast tall coconut

The tree starts fruiting between 6-7 years of age, producing 80 coconuts annually and attains a height of 100 feet tall when mature. This coconut tree is more tolerant to drought than East coast tall coconut tree.

3. Maypan coconut

This coconut tree was developed in Jamaica in the 1960's, it is a hybrid from the cross between Malayan dwarf and Panama tall. It is taller than Malayan dwarf but shorter than Panama tall and is resistant to lethal yellowing disease.

4. Panama tall

This palm tree is commonly called "pacific tall". The Panama tall is tolerant to adverse weather such as storm winds. It can attain a height of 90 feet when mature and is tolerant to wind and cold conditions.

5. Jamaica tall

The base of this palm tree is slightly swollen, getting narrower as it extends upwards. It has quick growth with a life span of 80 years and attains a height of 100 feet tall when mature. It requires enough moisture and produces between 100-200 coconuts per year.

2.2 Coconut oil

Coconut oil is derived from the copra of coconuts and the oil contains medium-chain fatty acid including Capric acid, Caprylic acid and Lauric acid.

BENEFITS OF USING COCONUT OIL

1. Controlling blood sugar: Coconut including it's water, flesh and oil contains essential nutrients like dietary fiber, healthy fats and minerals. These components work together to reduce the rate of sugar absorption in the bloodstream which prevents rapid spikes in blood sugar levels after meals.

2. Reducing stress: Coconut oil has antioxidant properties which fight oxidative stress in the human body which is often increased during physical or emotional strain. Coconut water also contains healing vitamins and constituents like riboflavin, thiamine, vitamin C, pathogenic acid and niacin which is known for relieving stress and lowering depression.

3. Fighting candida. A 2007 lab study found that coconut oil helped kill *Candida albicans* strain which may be due to its extract barrier function and anti-inflammatory properties.

2.3 PROCESSES OF COCONUT OIL PRODUCTION

Coconut oil can be extracted through either wet or dry process

1. Wet process

This uses coconut milk extracted from raw coconut rather than dried copra. The proteins

in the coconut milk create an emulsion of oil and water. To get the oil, the emulsion is to be boiled but it produces a discolored oil.

2. Dry process

This process requires that the copra be extracted from the shell and dried using sunlight or fire. The copra is pressed or dissolved in solvents, producing the coconut oil and a high protein, high fiber mash of low quality that is fed to animals.

2.4 TYPES OF PALMS AND THEIR YIELDS

1. Coconut palm (*Cocos nucifera)*

Cocos nucifera is a large palm, growing up to 30m tall, with pinnate leaves 4-6m long. On fertile soil, a tall coconut palm can yield up to 75 fruits per year, but more often yields less than 30.

2. Oil palm (*Elaeis guineensis*)

Elaeis guineensis is monocotyledonous. The leaves are pinnate and reach 3-5m long. The palm fruits take 5-6 months to develop from pollination to maturity. It is reddish, about the size of a large plum, and grows in large bunches. Each fruit is made up of an oily, fleshy outer layer (pericarp), with a single seed (the palm kernel) which is also rich in oil.

When ripe, each bunch of fruit weighs between 5 to 30kg depending on the age of the palm tree. Yield is 3-4 tones/hectare on an average.

3. Date palm (*Phoenix dactylifera)*

Phoenix dactylifera is cultivated for its edible fruits called dates. Date palms are slow growing and can grow for over 100 years of age when properly maintained. Date fruits are cylindrical in shape, long and about 2.5cm in diameter with color ranging from dark brown to bright red or yellow depending on the variety. Date fruits are consumed as sweets, snacked on their own or with confections and has a yield of 4-8 tons/hectare.

4. Areca palm (*Areca catechu)*

Areca nut is properly referred to as betel nut because of its usage for chewing with betel leaves. The nuts are used in Hindu weddings, symbolizing long-lasting marriage. Areca palm has a yield of 2-3 tons/hectare.

5. Sago palm (*Metroxylon sagu)*

Sago is a starch extracted from the pith or spongy core tissue of *Metroxylon sagu.* It is a major staple food for the lowland people of New Guinea. Sago palm grows quickly and it dominates in tropical swamp rainforests and is tolerant to highly acidic soils. It has the

ability to grow abundantly in heavy clay soils. It only flowers once in its lifetime and then dies. A single sago palm yields about 150kg sago.

6. Sugar palm (*Arenga pinnate)*

This is a medium sized palm, growing to 20m tall. *Arenga pinnate* suffers from red palm weevil, *Rhynchophorus ferrugineus.* The product of sugar palm are sap, fruit, fruit stalk, young shoot, fibers, leaves, starch and trunk. Sugar palm produces 20-30 liters per palm daily during tapping season.

7. Salak palm (*Salacca zalacca)*

The fruits grow in clusters at the base of the palm and are also known as snake fruit due to the reddish-brown scaly skin, which is removed before eating. The diversity in salak cultivars leads to a range of flavors, from intensely sweet to tangy and slightly sour, making it a fruit with a complex palate. Salak palm produces about 10kg/palm annually.

8. Bismarck palm (*Bismarckia nobilis)*

The Bismarck palm is native to Madagascar and grows to a height of 30-60 feet with a spread of 12-16 feet. The dark brown male and female inflorescences are produced on separate trees with females developing olive-brown fruit about 1.5 inches in diameter.

They are propagated by seeds and germinate slowly over a period of 6 to12 months. It can produce hundreds of fruits per season depending on age and environmental factors, it is not a high yield palm for commercial agriculture. The primary value of Bismarck palm is the role in landscaping and ornamental uses rather than fruit or oil production.

9. Rattan palm (*Calamus gibbsianus)*

Calamus gibbsianus is a specie of the rattan palm endemic to Malaysia. The stems are harvested for their cores, which are used for canes and furniture. It has a yield of 2-4 tons/ hectare annually.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials used for the study

1. Hammer
2. Stone
3. Scale
4. Knife
5. Plastic containers
6. Blender/ Grinder
7. Sieving clothes
8. Pot and spoon

3.2 Method of extracting coconut oil

The wet method was used;

1. A coconut was weighed using a scale
2. The coconut shell was broken/ cracked with the use of an hammer
3. The water was poured into a clean container
4. Using a knife, the copra was removed from the shell and placed in a clean bowl
5. The copra was rinsed and cut into tiny pieces to enable easy blending
6. After blending, the blended coconut was poured into a clean bowl and the chaff was separated from the milk with a sieve cloth
7. The milk was poured into a clean bowl and refrigerated for 12hours
8. After 12 hours, it was removed from the refrigerator and two layers were seen (the upper part containing the oil and the lower part containing water)

9. Then a spoon was used to scoop the upper part into a clean pot

10. The pot was placed on fire (firewood was used)

11. It was gradually stirred from time to time to avoid burning

12. After a while, it was observed that the milk was gradually converting to oil and this took about 20-30 minutes.

13. The pot was then removed from the fire and strained with a sieve cloth into a clean bowl to remove particles from the oil

14. The oil was then allowed to cook and it was poured into a container.

3.3 variables measured

Data collected were;

1. Weight of coconut (g)
2. Weight of coconut water (g)
3. Weight of copra (g)
4. Weight of coconut shell (g)
5. Weight of chaff (g)
6. Quantity of oil obtained (ml)

CHAPTER FOUR

RESULTS

The tables 1 and 2 provides a comprehensive analysis of the yield performance of two coconut types (Nigeria and Ghana coconuts), shows there was no statistically significant differences between Nigeria and Ghana coconut in terms of Copra, water, oil and chaff variables.

However, the difference between both types of coconut were significant for coconut and shell weight. In both cases, Nigeria coconut weighed heavier than Ghana coconut types.

Table 2 shows that the proximate composition of coconut chaff varied significantly between both types (Nigeria and Ghana coconut) for dry matter, crude protein, oil, ash and NFE except for crude fiber which was similar for both types of coconut. However, the proximate composition of coconut chaff was significantly better for Ghana coconut than Nigeria coconut for all variables except for the oil content which had 9.04 and 6.83 respectively for Nigeria and Ghana coconut.

Table 1: Comparison of Nigeria and Ghana Coconut varieties

VARIABLES	NIGERIA	GHANA	**P-VALUE**	SIGNIFICANCE
COCONUT (g)	557	400	0.002	*
SHELL (g)	170.6	117.3	0.004	*
COPRA (g)	273.3	237.3	0.188	NS
WATER (g)	146.6	44	0.018	NS
OIL (ml)	231	500.2	1.152	NS
CHAFF (g)	1513.2	1401.2	3.753	NS

*= significance at 5% level, NS= not significant

Table 2: Proximate Composition of Coconut Chaff

VARIABLES (%)	NIGERIA	GHANA	P.VALUE	SIGNIFICANCE
CP	14.15	13.98	0.061	NS
DM	86.23	86.43	0.033	*
CF	12.68	13.05	0.001	**
OIL	9.04	6.83	0.0009	**
ASH	3.25	3.58	0.02	**
NFE	61.53	67.21	0.0012	**

*= significant at 5% level, **= highly significant at 5% level, NS= not significant

CHAPTER FIVE

5.0 DISCUSSION

The result of this study gives insight into the production of coconut oil, showing the various stages of processing. The study compared the variables of Nigeria and Ghana coconut varieties, focusing on weight of the coconut, shell, water, copra and oil content. The findings indicate that Nigeria coconuts are significantly heavier in total weight, shell weight and water content, suggesting a larger and more moisture-rich variety. However, Ghana coconuts had a higher oil yield, which is crucial for coconut oil production.

Regarding coconut chaff, Nigeria coconut had slightly higher crude protein whereas Ghana coconut contained more carbohydrate (NFE) and mineral (ash). This implies that Nigeria coconut chaff may be better suited for livestock feed due to its higher protein content, while Ghana coconut chaff could be preferable for energy-rich applications.

5.1 CONCLUSION

In conclusion, Nigeria coconuts are significantly heavier and contain more water than Ghana coconut. Also, Ghana coconut have higher oil content but the difference was not statistically significant.

5.2 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed;

For oil production: Ghana coconut should be prioritized due to its higher oil yield.

For livestock feed: Nigeria coconut chaff is recommended due to its higher protein content.

REFERENCES

Abd-aziz. Sago starch and its utilization. *Journal of Bioscience and Bioengineering* (2002)

Agero AL, Verallo-Rowell VM. A randomized double-blind controlled trial comparing extra virgin coconut oil with mineral oil as a moisturizer for mild to ni moderate xerosis. *Dermatitis* 2004;15:109-16.

Alatawi KA, Alshubaily FA. Coconut products alleviate hyperglycaemic, hyperlipidemic and nephropathy indices in streptozotocin-induced diabetic Wistar rats. *Saudi Journal of Biological Sciences*. 2021 Aug 1;28(8):4224-31. [Cited on: 2023 August 12]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8324991/

Alexaki A, Wilson TA, Atallah MT, et al. Hamsters fed diets high in saturated fat have increased cholesterol accumulation and cytokine production in the aortic arch compared with cholesterol-fed hamsters with moderately elevated plasma non-HDL cholesterol concentrations. *J Nutr* 2004;134:410-5.

Alikamali M, Emadi SF, Mahdizadeh M, Emami Z, Akbari H, Khodabandeh-Shahraki S. Comparing the efficacy of breast milk and coconut oil on nipple fissure and breast pain intensity in primiparous mothers: a single-blind clinical trial. *Breastfeed Med*. 2023;18(1):30-36.

Amarasiri WALD and Dissanayake AS, Coconut fats. *Ceylon Med* J 51:47-51 (2006).

Athauda LK, Wichremasinghe AR, Kumarendran B and Kasturiratne A, An ecological study for Sri Lanka about health effects of coconut. *Ceylon Med* J 60:97-99 (2015).

Bourke, RM; Harwood T (2009). Food and Agriculture in Papua New Guinea. Australian National University. p. 327. ISBN 978-1921536601.

Chinwong, S., et al. (2017). Daily consumption of virgin coconut oil increases high-density lipoprotein cholesterol levels in healthy volunteers: A randomized crossover trial.

Coconut | description uses, & facts | Britannica [Internet]. 2023 [cited 2023 Sep 22]. Available from: https://www.britannica.com/plant/coconut

Coconut oil. Transport Information Service, German Insurance Association, Berlin. 2015.

Cocos L., Sp. Pl.: 1188 (1753)". World Checklist of Selected Plant Families. Royal Botanic Gardens, Kew. 2022. Archived from the original on May 29, 2022. Retrieved May 29, 2022.

Cosiaux, A.; Gardiner, L.M.; Couvreur, T.L.P. (2016). "*Elaeis guineensis*". IUCN Red List of Threatened Species. 2016. IUCN: e.T13416970A13416973. doi:10.2305/IUCN.UK.2016-3.RLTS.T13416970A13416973.en. Retrieved 1 September 2021.

Dai Y, Peng L, Zhang X, Wu Q, Yao J, Xing Q, Zheng Y, Huang X, Chen S, Xie Q. Effects of coconut water on blood sugar and retina of rats with diabetes. *PeerJ.* 2021 Jan 29;9:e10667. [Cited on: 2023 August 12]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7849505/

Elaeis guineensis . Germplasm Resources Information Network. Agricultural Research Service, United States Department of Agriculture. Retrieved 12 December 2017.

Elaeis guineensis Select. Strip. Amer. Hist.: 280 (1763). World Flora Online. World Flora Consortium. 2022. Retrieved 2 December 2022.

FAO, Agricultural Journals.

FAO, International Palm Oil Council.

FAO, Sugar Palm Research Studies.

Florido, Helen B.; de Mes, Priscilla B. (2003). "Sugar palm [Arenga pinnata (Wurbm.) Merr.]" (PDF). *Research Information Series on Ecosyste*ms. 15 (2): 1–7.

Flour or meal of sago, starchy roots or tubers (HS: 110620) Product Trade, Exporters and Importers | OEC". OEC - *The Observatory of Economic Complexity*. Retrieved April 26, 2022

Gans WM and Kauwell GPA, Coconut oil: a heart healthy fat. [Online]. University of Florida (2017). Available: https://edis.ifas.ufl.edu/fs289.

Grimwood et al., 1975, p. 29.

Horticultural Crop Research Institute.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5745680/

Intahphuak S, Khonsung P and Panthong A, Anti-inflammatory, analgesic, and antipyretic activities of virgin coconut oil. *Pharm Biol* 48:151-157 (2010).

International Date Palm Center.

Jeyakumar C, Sze-Yen T, Elaine WP and Alejandro GM, Effects of liquid oil vs. oleogel co-ingested with a carbohydrate-rich meal on human blood triglycerides, glucose, insulin and appetite. *Food Funct* 8:241-249 (2017).

Karim, A. A. (2008). "Starch from the Sago (*Metroxylon sagu*) Palm Tree—Properties, Prospects, and Challenges as a New Industrial Source for Food and Other Uses" (PDF). *Comprehensive Reviews in Food Science and Food Safety*. 7 (3): 215–228. doi:10.1111/j.1541-4337.2008.00042.x. PMID 33467803.

Pearsall, J., ed. (1999). "Coconut". Concise Oxford Dictionary (10th ed.). Oxford: Clarendon Press. ISBN 0-19-860287-1.

Peng, Lu; Hou, Youming (2017). "13. Red Palm Weevil Rhynchophorus ferrugineus (Olivier)". In Wan, Fanghao; Jiang, Mingxing; Zhan, Aibin (eds.). Biological invasions and its management in China. Dordrecht, Netherlands: Springer. pp. 245–256/xiv+366. doi:10.1007/978-94-024-0948-2_13. ISBN 978-94-024-0946-8. OCLC 984692367. S2CID 91164620. ISBN 978-94-024-0948-2.

Phoenix dactylifera L. — The Plant List". www.theplantlist.org. Archived from the original on 17 April 2019. Retrieved 12 June 2015.

Phoenix dactylifera L." Plants of the World Online | Kew Science. 2024. Retrieved 1 May 2024.

Phoenix dactylifera". Germplasm Resources Information Network. Agricultural Research Service, United States Department of Agriculture. Retrieved 10 December 2017.

Riffle, Robert L.; Craft, Paul (2003). An Encyclopedia of Cultivated Palms. Portland, Oregon, USA: Timber Press. ISBN 0-88192-558-6. OCLC 49760622.

Sago Palm Research Institute.

Umesh Patil, Soottawat Benjakul (13 July 2018). "Coconut Milk and Coconut Oil: Their Manufacture Associated with Protein Functionality". *Concise Reviews & Hypotheses in Food Science.* 83 (8): 2019–2027. doi:10.1111/1750-3841.14223. PMID 30004125. S2CID 51617929.

Zumbroich, Thomas J. (2008). "The origin and diffusion of betel chewing: A synthesis of evidence from South Asia, Southeast Asia and beyond". *e-Journal of Indian Medicine.* 1 (3): 87–140.