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DETERMINATION OF ETHANOLIC EXTRACTION SKILLS REQUIRED BY FISH FARMERS FOR USE AS FERTILITY ENHANCER IN FEMALE TILAPIA FISH (*OREOCHROMIS NILOTICUS*) FOR SUSTAINABLE FOOD SECURITY IN FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA

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Abstract

The study examined bitter kola Garcinia kola seed extraction skills required by fish farmers in for extracting ethanolic extracts for fertility enhancement in female tilapia fish *Oreochromis niloticus* for sustainable food security in Federal Capital Territory (FCT) Abuja. Three research questions guided the study while three hypotheses were formulated and tested at 0.05 level of significance. The study employed survey research design. The instrument used for the study was a 27-item structured questionnaire titled 'Ethanol Extraction Skills Questionnaire ((EESQ)'. The instrument was validated by three experts in the Department of fisheries and animal nutrition, University of Abuja. Cronbach alpha method was used to determine the internal consistency of the instrument and reliability coefficient of 0.98 was established. The questionnaire was administrated to 226 respondents. The SPSS (Statistical package for social science) was used to analyze the data. Tools for data analysis were mean and standard deviation (to answer the research questions) while t-test was used to test the null hypotheses formulated. Findings from the research revealed that all the 27 skill items were required by fish farmers for extraction of ethanolic extract for use as fertility enhancer in female tilapia fish (*Oreochromis niloticus*). It was recommended amongst others that the identified skills in this study be used by extension agents and skills training centers for training fish farmers in FCT.

Keywords: Ethanolic extracts of Garcinia kola, Skills, Fertility enhancer, *Oreochromis niloticus*, Sustainable Food Security.

Introduction

Bitter kola **(*Garcinia kola*)** commonly known as "male kola" or "Aku ilu" in Igbo, "Orogbo" in Yoruba and "Namijin goro" among the Hausas is an important seed used for centuries in folk medicine to treat ailments from coughs to fever (Ipek, 2019). According to the Center for International Forestry Research, *G. kola* trade is still important to the indigenous communities and villages in Nigeria. The tree is commonly found in the humid lowland forests of Nigeria, Cameroun, Ghana and the Benin Republic. The plant is now attracting considerable interest as a possible source of pharmaceutically important drugs and fertility enhancers in the fishery enterprise and is grown in all types of soil in the tropics (Alatise, 2017; Abaho, Masembe, Akoll & Jones, 2022).

G. Kola belongs to the plant kingdom, family Guttiferae in the phylum vascular plant, class of dicotyledons and genus Garcinia (Abaho et al., 2022). The plant has been traditionally used for medicinal purposes in humans and as fertility enhancers for fish (Sayyar, Yunus & Muhammed, 2009). It possesses anti-inflammatory, anti-parasitic, wound healing, insecticidal, disinfectant anti-mestatic, anti-tumor, co-agulant, an animal feed additive and an anti-diarrhea (Megbowon and Mojekwu, 2014; Amal, Mohammed, Bader & Alotaibi, 2022). In view of these numerous benefits of *G. kola* and with specific reference to fish enterprise, fish farmers require special skills in the extraction of its ethanolic fertility enhancer for Tilapia fish. Buttressing this assertion, Dada and Ajilore (2009); Abaho et al. (2022); Chukwudi-Emelike, Ovie & Onyewuchi (2022) noted that production and commercialization of plant extracts for enhancing fertility in fishes is hampered by lack of standardized information on extract preparation, optimal dosages, and skills required in extraction.

According to Alatise (1988); Chukwudi-Emelike et al. 2022), *G. kola* is a medicinal and indigenous plants that have been used for treatment of a number of ailments in animals and humans and to enhance fertility in fish, they explained that modern scientific research has confirmed the pro-fertility effects of ethanolic extracts from *G. kola*; however, they noted that there is death of skills in *G. kola* extraction for its ethanolic extracts, a fertility enhancing agents in fish. Dada and Ajilore (2009), Chukwudi-Emelike et al. (2022) all agree that *G. kola* has a promising pro-fertility agent in fish with possible minimal side effects, availability, acceptability, accessibility and affordability but the skills to extract the ethanolic extract of *G. kola* is lacking.

There are various ways through which individuals are trained to acquire skills. This, Okoji, (2001) as cited in Wever, Agbulu and Hellen (2018), could be in the form of workshops, short term courses, participation in seminars and further educational programmes.

Sayyar et al. (2009); Ipek (2019); all stated that extraction of ethanol from *G. kola* seed traditionally involves the following:

i. Sun-dry the seed for few days
ii. Remove the outer coating
iii. Chopped the seeds int bits
iv. Oven-dry
v. Grind the seed into a fine powder by pounding in mortar
vi. Extract by sieving
vii. Add 20g of the extract and dissolve in 100ml of distilled water; A *G. kola* aqueous extract with a concentration of 200mg/ml is achieved.

The authors further stated that modern skills of extracting ethanolic extract from *G. kola* seed involves;

i. Sun-dry the seed for few days
ii. Remove the outer coating
iii. Chopped into smaller pieces
iv. Processed into smooth powder to achieve 200mg
v. Extract ethanolic extract
vi. Mix the extract with 100ml of ethanol and allow to stand for 72hours
vii. Filter the mixture using Whatman No. 1 filter paper (Maidstone, UK)

viii. Concentrate the filtrate in a Rotary Evaporator
ix. Take the mixture for a steam bath where it was evaporated to produce a brownish-black residue (Sayyar et al., 2009; Ipek, 2019, Chukwudi-Emelike et. al, 2022)

Marketing skills of *G. kola* processed extracts as outlined by Wever, Agbulu and Henlen (2018); Alatise (2019) include but not limited to;

1. Carry out market survey
2. Package the extracts in suitable containers
3. Brand/label the product to include manufacture period and expiry period
4. Grade the extracts
5. Fix prices on the extract containers accordingly
6. Sell the extracts at appropriate price
7. Advertise the processed garcinia seed extracts
8. Record daily sales
9. Calculate income and expenditure to determine profit and loss

The process of extracting ethanolic extract from *G. kola* requires both traditional and modern skills. Alatise, (2019); Amal, Mohammed, Bader and Alotaibi (2022), Wever, et.al. (2020) reported that ethanolic extraction from Garcinia seeds traditionally involves preparing the seeds, roasting the seeds using frying pans, pounding the seeds by mortar and pestle to a paste, filtering the extract by basket and sedimentation method. The modern skills of *G. kola* extraction involve putting seeds in a grinding machine and grinding it into paste, pressing the paste using the stork Hydraulic pressers by applying pressure, opening the valves, pressing the plunger until the extract inside comes out. In the opinion of Aborderin (2010); Godwin, Luckenbach, & Borski, 2023), modern processing skills are based on mechanical technology and are generally grouped into three basic skills: *G. kola* seed preparation, extract pressing and refining. After undergoing all these processes using the relevant skills, the ethanolic extract of *G. kola* is now ready for inclusion into the fish ration as fertility enhancer.

The term "skill" means the ability to do something well. It is a manifestation of acquired knowledge. Skill involves the acquisition of performance ability through repetitive performance of an operation (Osinem & Nwoji, 2015**).** Skills in the opinion of Williams (2005) can be described as the knowledge, competencies, attitudes and judgement required for the successful performance of a task. Wever (2015); Longshal, (2023) described skills as behavioural attitudes which are required for the successful performance of a task to be identified and the design instruction to produce the skills. Ekele cited in Longshal, (2023) explained skills as a task-oriented activity with the knowledge and competency to perform such assigned task. Task here involves psycho productive activities that lead to adequate performance. In the context of this study, skills in extraction of *G. kola* ethanolic extracts as fertility enhancer in female Tilapia fish (*Oreochromis niloticus)* is an activity which involves regular practice and of which the fish farmers ought to acquire.

Tilapia is the second most farmed food fish after carps globally (Abaho et al., 2022). According to the Food and Agriculture Organization of the United Nations (FAO), the global production of tilapia has continued to grow, rising from 3.1 million tons in 2010 to 5.6 million tons in 2018 (FAO, 2020). This has highlighted the significant contribution of the tilapia industry to the global economy as one of the world's primary sources of proteins for human consumption (Abaho et al., 2022).

Oreochromis niloticus also known as the Nile tilapia *is* a specie of tilapia and a native of parts of Africa (FAO, 2017; Wikipedia 2024). The Nile tilapia reaches up to 60cm (24 inches) in length and can exceed 5kg; as typical of tilapia, males reach a larger size and grow faster than females (Abaho et al., 2022). Nile tilapia is an excellent aquatic animal rich in protein globally, and a source of income to farmers. The Nile tilapia is prolific in reproduction and the largest tilapia specie in size hence attracting fish farmers for profitabity due to the comparative advantage (Alatise, 2019).

According to Ghosal, Mukherjee and Chakraborty (2021), the exponential increase in tilapia production is related to the suitable aquacultural attributes: (a) ease to breed in captivity (b) having a short production cycle because of fast growth rate (c) acceptability of artificial feeds after yolk-sac absorption and (d) marketability. Explaining further, FAO (2020) noted that technology advancements, including control of early maturity and prolific breeding, have also contributed to the expansion of tilapia's global production. This justifies the need to sustain and exceed the current increase by encouraging plant-based, organic fertility enhancers extraction skills by fish farmers in FCT for sustainable food security in Nigeria's Federal Capital, Abuja and indeed the country at large.

Fertility enhancers are pro-fertility agents used in fish seed production (Amal, Mohammed, Bader and Alotaibi, (2022). According to Alatise (1988); FAO (2020 cited in Abaho, Mensembe, Akoll and Jones (2022); Godwin, Luckenbach, and Borski (2023), the ethanolic extract of *G. kola*, is an indigenous plant with a pro-fertility agent in fish with possible minimal side effects, availability, acceptability, accessibility and affordability. These attributes informed the researchers' zeal to determine skills required by fish farmers for extracting ethanol for fish fertility enhancement.

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (World Bank, 2020; FAO, 2022). FAO asserted that a nation is considered food secure when a sufficient, stable and safe supply of food is available to satisfy basic needs and market demand, and a household is considered food secured when it can produce or obtain enough food to meet all of its member's nutritional needs. However, National or household food security does address the fact that over-exploitation of natural resources jeopardizes the very future of the household farm enterprise. It is therefore, useful to consider sustainable food security through which national and household food security is assured and national resources are managed sustainably. Sustainable food security therefore, encompasses hunger and poverty alleviation to address environmental sustainability (Wever, Agbulu & Helen 2018).

This study intends to determine *G. kola* extraction skills required by fish farmers for ethanolic extracts which will be used as fertility enhancer in female *Oreochromis niloticus* and for sustainable food security in Federal Capital Territory.

The views, opinions and submissions of the authors reviewed above guided the researcher in identifying skills required by fish farmers in extracting ethanolic extracts from G. kola seed for use as a fertility enhancer in female (*Oreochromis niloticus)* to ensure sustainable food Nigeria's capital, FCT Abuja

Purpose of the Study

The purpose of this study is to determine ethanolic extraction skills required by fish farmers for use as fertility enhancer in female (*Oreochromis niloticus)* to ensure sustainable food security in FCT. Specifically, the study sought to:

i. Identify traditional skills required by fish farmers and extension agents in garcinia seed extraction in FCT.
ii. Identify modern skills required by fish farmers and extension agents in garcinia seed extraction in FCT.
iii. Identify marketing skills required by farmers and extension agents for *G. kola* extracts.

Research Question

i. What are the tradition skills required by fish farmers and extension agents in *G. kola* extraction in FCT?
ii. What are the modern skills required by fish farmer and extension agents in *G. kola* extraction in FCT?
iii. What are the marketing skills required by fish farmers and extension agents for ethanolic extracts of *G. kola* in FCT?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance.

1.There is no significant difference in the mean responses of fish farmers and extension agents on the traditional skills required by fish farmers in extracting Garcinia seed extracts in FCT.

2.There is no significant difference in the mean responses of fish farmers and extension agents on the modern skills required by farmers in extracting Garcinia seed extracts in FCT.

3.There is no significant difference in the mean responses of farmers and extension agents on marketing skills required by fish farmers and extension agents on processed *G. kola* ethanolic extracts.

Materials and Method

Design

Survey research design was used. In the opinion of Emaikwu (2012), a survey research design is one in which a group of people or items is studied by collecting and analyzing data from a few people considered to be a representative sample of the entire population. This design is therefore appropriate for the study since it collected and analyzed data on *G. kola* extraction skills required by fish farmers for ethanolic extracts to be used as fertility enhancer in female tilapia fish for sustainable food security in FCT.

The study was conducted in the Federal Capital Territory (FCT), Abuja. The study was suitable

for FCT because of the numerical strength of fish farmers. Furthermore, FCT is an agrarian State with a fast-growing fish farming population. This teaming and promising population of fish farmers requires better skills and techniques to improve the quantity and quality of their products to meet the demand of teaming consumers.

The population for the study was 226 consisting of fish farmers and Agric. extension agents. No sampling was done since the entire population was used because the size of the entire population was manageable.

Instrument for Data Collection

A structured questionnaire made up of 27 items was developed for collecting data in accordance with the research questions. The questionnaire was structured on a four-point rating scale of Highly Required (4) Required (3) Fairly Required (2) Not Required (1). The respondents were made to rank the responses to an item based on the level at which the item is required in the extraction of *G. kola* ethanolic extracts.

The questionnaire was face and content-validated by three experts one each from the Department of Agricultural Education, animal nutrition and fisheries

Cronbach Alpha reliability technique was used to determine the internal consistency of the items of the questionnaire which yielded a reliability coefficient of 0.96.

The questionnaire copies were personally administered by the researcher with the aid of three research assistants. Two hundred and twenty-six copies of the questionnaires were administered and same number retrieved.

Data collected was analyzed using mean and standard deviation to answer the research questions while t-test statistics was used to test the hypotheses at 0.05 level of significance. All items with mean value of 2.50 and above were accepted as skills required by fish farmers for *G. kola* seed extraction while those below 2.50 were rejected. In using the t-test to test, hypotheses of no significance were upheld at 0.05 level of significance, but where t-calculated is greater than t - table, the hypotheses of no significance was rejected.

Result

Research Question 1

What are the mean achievement scores of pupils taught basic science using mother tongue and those taught using English language?

Results

Table 1: Mean Ratings and Standard Deviation of Responses of Agricultural Extension Agents and Fish Farmers on Traditional Skills Required by Fish Farmers in Ethanolic Extraction from *G. kola* in FCT *(n=226)*

S/N	Item	$\overline{X_1}$	$\overline{X_2}$	SD_1	SD_2	Remark
1	Collect the seed	2.9143	3.0714	1.19146	1.11981	Required
2	Clean the seeds	3.1686	3.5357	1.12417	1.17006	Required
3	Sun-dry the seed for few days	3.0029	2.3214	1.24504	1.21879	Required
4	Remove the outer coating	2.8600	3.7857	.97260	1.44932	Required
5	Chopped the seeds into bits	3.0829	2.4643	1.13375	1.23175	Required
6	Oven – dry	3.1657	3.3929	1.11307	1.44886	Required
7	Pound the seeds into powder using mortar	3.1314	3.5000	1.10476	1.45297	Required
8	Boil the powder	3.1171	2.4643	1.15329	1.31887	Required
9	Filter to get ethanolic extract	3.1143	3.8929	.92626	1.34272	Required
	Grand Mean	**3.0600**	**3.1500**			

Key: $\overline{x_1}$ = Fish farmers' mean; $\overline{x_2}$ = mean of Agricultural Extension Agents, SD_1 = Fish farmer' Standard Deviation and SD_2 = Standard Deviation for Agricultural Extension Agent Table 1 reveals that all the skill items had their mean rantings ranging from 3.06 – 3.150. Each mean was above cut-off point of 2.50 implying that all the 9 items were required by fish farmers as skills for *G. kola* extraction. The standard deviations of all the skill items range from 0.92-1.25 for fish farmers and 1.12 – 1.45 for Agric. extension agents respectively which implies that the respondents were not far from the mean in their responses.

Table 2: Mean Ratings and Standard Deviation of Fish Farmers and Agricultural Extension Agents on Modern Skills Required by Fish Farmers in FCT for Extracting Ethanolic Extract from Garcinia seed (*n=226*)

S/N	Item	$\overline{X_1}$	$\overline{X_2}$	SD_1	SD_2	Remarks
1	Prepare *G. kola* seed by cleaning	3.1857	3.2929	1.08103	.98403	Required
2	Sun-dry the seed for few days	3.1671	3.0457	1.18319	1.27146	Required
3	Remove the outer coating	3.3500	3.3543	1.09770	.96166	Required
4	Chopped into smaller pieces	3.4028	2.9671	1.05607	1.38613	Required
5	Processed into smooth powder to achieve 200mg	3.2814	3.0467	1.09302	1.16005	Required
6	Extract ethanolic extract	2.8671	3.0000	1.25521	1.33776	Required
7	Mix the extract with 100ml of ethanol and allow to stand for 72hours	3.4943	2.9654	1.04541	1.12312	Required
8	Filter the mixture using Whatman filter paper	3.3171	3.0464	1.08222	1.32462	Required
9	Concentrate the filtrate in a Rotary Evaporator	3.326	3.3424	1.2242	1.27146	Required
10	Take the mixture for a steam bath where it was evaporated to produce a brownish-black residue	3.532	3.3386	1.10786	.97222	Required
	Grand Mean	**3.1900**	**3.1400**			

Key: $\overline{x_1}$ = fish farmer's mean, $\overline{x_2}$ = Agricultural Extension Agents mean, SD_1 = fish farmers' standard deviation and SD_2 = Agricultural Extension Agents' standard deviation Table 2 reveals that all the skill items had their means range from 3.14-3.19. All the items had their mean above 2.50 cut-off point implying that all the 10 items were required by farmers as modern skills used for extracting ethanolic extract from *G. kola*. Similarly, the standard deviation of the skill items ranged from 1.40 – 1.17 for fish farmers and 0.96 – 1.34 for Agric. extension agents respectively meaning that respondents were not far from each other in their response

Table 3: Mean Ratings and Standard Deviation of Farmers and Agricultural Extension Agents on Skills Required by Fish Farmers for Marketing Ethanolic Extracts from *G. kola* *(n=226)*

S/N	Item	$\overline{X}_1$	$\overline{X}_2$	SD_1	SD_2	Remarks
1	Carryout market survey	3.3600	3.5357	1.04435	.69293	Required
2	Packaged the oil in suitable container	3.2086	3.2500	1.05680	1.17458	Required
3	Grade the processed oil	3.0200	3.4286	1.24027	.83571	Required
4	Fix prices on the oil containers accordingly	3.0886	3.0062	1.15087	1.24722	Required
5	Sell the oil at appropriate price	3.0971	3.1071	1.06346	1.03062	Required
6	Advertise the processed Jatropha oil	3.0514	2.8214	1.09842	1.15642	Required
7	Record daily sales	3.1857	3.0714	1.09299	1.01575	Required
8	Calculate income and expenditure to determine profit and loss	3.2943	3.2857	.94655	.93718	Required
	Grand Mean	**3.1600**	**3.1800**			

Key: $\overline{x}_1$ = Fish farmers' mean, $\overline{x}_2$= Agricultural Extension Agents' mean, SD_1 = fish farmers' standard deviation and SD_2= Agricultural Extension Agents' standard deviation.

Table 3 shows that all the skill items had their means ranging from 3.16 – 3.18, which indicate that all the items had their means above 2.50 cut-off point implying that all the 8 skill items were required by fish farmers in marketing ethanolic extract. The standard deviations of the skill items ranged from 1.04-1.5 for fish farmers and 0.69 – 1.15 for Agricultural extension agents respectively which indicates that the respondents were not far from the mean in their responses.

Table 4: t-test Result on Traditional Skills of Extracting Ethanolic Extract From *G. kola*

Variable	N	Mean	Std.	Dev	df	t-cal	Remarks
Fish farmer	216	3.06	2.64	376	-3.204	1.96	Not significant
Ext. Agents	10	3.15	2.00				
Total	**226**						

N= number of respondent and D f = degree of freedom

Table 4 shows that fish farmers had mean of 3.06 while agric. Extension agents 3.15. the t-calculated was -3.204 while the t-tabulated value was 1.96. This revealed that there was no significant difference in the mean responses of fish farmers and agric. Extension agents in ethanolic extraction from *G. kola*. Therefore, the hypothesis of no significant difference was upheld for all the items

Table 5: t-test Result on Modern Skills of Garcinia oil Extraction

Variable	N	Mean	Std.	Dev	df	t-cal	Remarks
Fish Farmer	216	3.15	2.64	376	-3.204	1.96	Not significant
Ext. Agents	10	3.14	2.62				
Total	**226**						

N = number of respondents and df= degree of freedom

Table 5 indicates that fish farmers had mean of 3.15 while extension agent 3.14 with the standard deviation of 264. The t-calculated was -3.643 while the t-tabulated value was 1.96. This result show that there was no significant difference in the mean responses of fish farmers and Agric extension agents in ethanolic extraction skills required in Garcia seed. Therefore, the hypothesis of no significant difference was upheld for all the items

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Table 6: t-test Result on Marketing Skills of *G. kola* Extract

Variable	N	Mean	Std.	Dev	df	t-cal	Remarks
Fish Farmers	216	3.16	2.46	376	-3.643	1.96	Required
Ext. Agents	10	3.18	2.11				
Total	**226**						

N = number of respondents and df = degree of freedom

Table 6 reveals that fish farmers had mean of 3.16 while Agric. extension agents is 3.18 with the standard deviation of 2.46. The t- calculated was -3.643 while the t-tabulated value was 1.96. The implication is that there was no significant difference in the mean responses of fish farmers and Agric. extension agents on marketing skills required by farmers and extension agents on ethanolic extract from *G.kola*

Discussion of Findings

The study examined *G. kola* extraction skills required by fish farmers for ethanolic extract as fertility enhancer in *Oreochromis niloticus* for sustainable flood security in FCT. Mean responses of the respondents revealed that all the traditional skills are required by fish farmers in extracting ethanolic extract from *G. kola.* This implies that traditional skills are still valuable and affordable in ethanolic extract production process compared to modern extractors. Therefore, it should be maintained. The findings are in agreement with the views of Wever, Agbulu and Helen (2018) who affirmed that skills are potentials required by farmers through training, which ensures proficiency and competency in the performance of occupational task.

With regards to modern skills of extracting *G. kola* extract, all the 10 items are recognized and are required by farmers in extracting *G. kola* extract. Corroborating this results, Wever, Agbulu and Helen (2018) posited that modern skills of extracting ethanolic extract from *G. kola* involves putting seeds in a heating drum and heating for an hour, grinding it with crushing machines, pressing the paste using the stock Hydraulic presser by applying pressure and opening the valves, pressing the plunger until the *G. kola* extract inside comes out.

Aboderim (2010), Sayyer (2009) and Wever (2018) noted that modern ethanolic extraction and processing skills are based on mechanical technology and are generally grouped into three basic skills such as *G. kola* seed preparation, *G. kola* pressing and *G. kola* extract refining.

Findings regarding marketing skills required by farmers on *G. kola* processed ethanolic extract revealed that all the 8 items are skills required by farmers and extension agents in marketing processed extract of G. *kola*. This findings is in agreement with the views of Ivan, Charles, Peter and Clifford (2022); Rearddon, Timmer, Barrett and Berdegue (2003) cited in Wever, Agbulu and Helen, (2018), Chukwudi, Ovie and Onyebuchi (2022) who stated that agricultural marketing covers the services involved in moving agricultural products from the farm to the final consumers.

Regarding the research hypotheses, the study found out that there was no significant difference in the mean responses of Agricultural extension agents and fish farmers with respect to traditional, modern and marketing skills required by farmers and Agric. extension agents in *G. kola* extract extraction.

Conclusion

The findings of the study identified both traditional and modern skills of extracting ethanolic extract from *G. kola* as well as the skills involved in marketing refine *G. kola* extract. The study further established that all the skills are required by fish farmers in *G. kola* extraction and marketing. Fish farmers in FCT are encouraged to make use of the identified skills to improve and enhance *Oreochromis niloticus* farming in FCT for sustainable food security.

Recommendations

Based on the findings of the study, the following recommendations were made:

i. The Federal Capital Territory Administration (FCTA) should

ensure that the identified skills in this study are used by extension agent and entrepreneurship training centers in training fish farmers in FCT and environs

ii. FCTA Administration should ensure that *G. kola* extract marketing skills are integrated in Agric. Education programme for training interested individuals.

iii. FCTA Administration should ensure that findings of the study are made available to the stake holders in FCT who will put in place marketing channels for *G. kola* extract

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