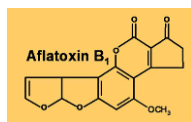


EXPANDING EXPORT OF SESAME SEED AND SHEANUT/BUTTER THROUGH IMPROVED SPS CAPACITY BUILDING FOR PUBLIC AND PRIVATE SECTOR

PHYSICO – CHEMICAL CHARACTERISATION OF SHEA NUTS AND SHEA BUTTER IN NIGERIA

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Healthy Shea nuts



Aspergillus sp

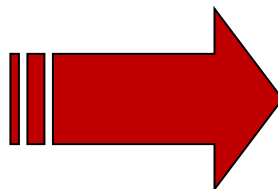


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1. PHYSICO – CHEMICAL CHARACTERISATION OF SHEA NUTS AND SHEA BUTTER IN NIGERIA

1.1. INTRODUCTION

At the commencement of the STDF Project, the physico- chemical characterization studies of Shea nuts and butter were carried out. Laboratory tests were carried out on samples taken from sixteen local government areas of four states namely Niger, Kwara, Oyo and Kebbi states in the south west part of the country bordering mid-north west. While the results confirmed presence of moulds and bacteria, the organochlorines and organophosphates were not detected. Conversely, mycotoxins were detected in shea nuts; though at levels that were below permitted maximum level with the exception of one state.

Overall the safety qualities of shea nuts and butter at the commencement of the project are within the safety limits]. Shea nut the seed from shea tree (*Vitallera paradoxa*) in Nigeria and shea butter (fat extracts from shea nuts) were characterised at the commencement of SPS Project 172. The aggregate results obtained from the study are as reflected in Tables 1 and 2.

Samples from sixteen local government areas of the four Shea nut/butter producing states in Nigeria were analysed. The sampling sites were Niger, Kebbi, Kwara and Oyo States. There were two streams of sampling: 1st Stream and 2nd Stream, the results from the first stream sampling are as reflected in Tables 3 and 4; while second stream results are reflected in Table 5 and 6. However since there were issues of inadequate sampling in respect of first stream, limited tests were carried out as recorded in Tables 3 and 4. Due to this reason, Tables 1 and 2 principally reflect summary of mean values from the comprehensive results obtained from 2nd Stream (Tables 5 and 6), which were utilised for characterization. The incompleteness of Tables 3 and 4 notwithstanding, the results were still presented because comparison of some tested parameters with results from 2nd stream presented useful observations under discussion.

The samples were tested for both quality and safety characteristics. Some of the quality characteristics that were measured include: Saponification Value, Iodine Value, Moisture Content, Ash content, Oil Content, Peroxide Value and Trace Metals and Fatty Acid Profile. The safety

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parameters analysed were: Total Aflatoxins, pesticides residues and aerobic mesophilic count; others were mould count, coliform count and presence of *Esherichia coli* bacteria.

1.2. METHOD OF ANALYSIS

All proximate analyses for quality determination, chemical, microbiological contaminants and other characterization parameters were performed as described by the Association of Official Analytical Chemist (AOAC) 1990; 2000 and 2005; QuEchERS Method and International Standards Organization (ISO) Method. The summaries are as tabled hereafter.

The Characterization Parameter	Analytical Method
Moisture Content:	The percentage (%) moisture content was analysed by oven drying method which involves the measurement of weight loss due to evaporation according to AOAC Official methods of analysis (40.1:04, 2005).
Total Ash:	The total ash content was determined at 500-550°C according to AOAC (method 40.1.08 2005)
Trace Metals:	Mineral contents were determined by Atomic Absorption Spectrometer (AAS) flame method in accordance to AOAC (method 991.11, 2005). The presence of trace/heavy metals in the shea butter samples were determined by qualitative analysis was (Reinsch test)
Oil Content:	Soxhlet extraction method was employed for the extraction of the oil and quantified gravimetrically, according to AOAC (method 945.16, 1990)
Free Fatty Acid:	Titration method was applied in the determination of FFA in accordance to AOAC (method 940.28, 41.1.21, 2005)
Saponification Value:	Titration method was employed in accordance to AOAC (method 920.160, 41.1.18 2005)
Peroxide Value:	Titration method in accordance to AOAC (method 965.33, 41.1.16, 2005) was employed
Iodine value:	The Iodine value is a measure of the degree of unsaturation in fats and oils. The triglycerides of unsaturated fatty acids present in fats and oils, reacts with a definite amount of halogen (Iodine). The Wij's method in accordance to AOAC (method 920.159, 2000) was employed.
Total Aflatoxins:	Total Aflatoxin comprising of Aflatoxin B ₁ , B ₂ , G ₁ and G ₂ was analysed according to AOAC (method 999.07, 49.2.29, 2005)
Pesticide Residues:	Organochlorine and organophosphate pesticides residues were analysed according to QuEChERS Method, EN15662.2007

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The Characterization Parameter	Analytical Method
Microbiological Analysis:	Total aerobic mesophilic bacteria in shea nut/butter was analysed in accordance to ISO 4833:2003 while Coliform and <i>Escherichia coli</i> bacteria were analysed according to ISO 4832:2006 and ISO 16649-2:2001, respectively. Yeast and moulds were analysed according to ISO 21527-2 2008
Fatty Acid Profile:	The fatty acid composition of the fat extracts of shea nuts and shea butter samples was determined by conversion of the triglyceride esters to their more volatile methyl esters and quantified with Gas Chromatograph using Flame Ionization Detection (GC-FID) in accordance to AOAC (method 969.33- 2005)

1.3. THE RESULTS

Table 1: Characterisation of Sheanut/Butter in Nigeria at the Commencement of STDF Project 172

s/n	PARAMETERS	EXPECTED (Units)	PROJECT COMMODITIES	
			Sheanut	Sheabutter
			Range	Range
1	Moisture ¹	(%)	2.69 - 6.87	0.026 - 2.17
2	Ash ²	(%)	1.99 - 3.59	ND
3	Zinc ³	(mg/kg)	0.12 - 4.06	ND
4	Copper ³	(mg/kg)	0.00 - 0.04	ND
5	Calcium ³	(mg/kg)	0.99 - 19.4	ND
6	Magnesium ³	(mg/kg)	1.33 - 1.34	ND
7	Iron ³	(mg/kg)	0.24 - 1.44	ND
8	Lead ³	(mg/kg)	ND	ND
9	Cadmium ³	(mg/kg)	ND	ND
10	Total Aflatoxin ⁴	(µ/kg)	0.05 - 1.0	-
11	Oil Content ⁵	> 45 (%)	43.0 - 65.4	99.41 - 99.97
12	FFA (as Oleic) ⁶	8 (%) max	4.0 - 13.6	1.4 - 7.8
13	Sapon. Value ⁷	170-190 (mgKOH/g)	171 - 188	171.11- 189.34
14	Peroxide Value ⁸	10 (mEq/Kg)	2.2 - 8.8	1.2 - 9.8
15	Iodine Value ⁹	(WIJ's)	50 - 57.11	50.01- 54.75
16	Melting Point ¹⁰	30-40 (°C)	30 - 35	28 - 41
17	Organochlorine ¹¹	(%)	ND	ND
18	Organophosphate ¹¹	(%)	ND	ND
19	Aerobic Count ¹²	10000(cfu)	140 - 6200	30 - 1260
20	Mould Count ¹³	500(cfu)	40- 820	10 - 120
21	Coliform Count ¹⁴	100(cfu)	0- 1600	60 - 160
22	E. coli ¹⁵	0(cfu)	0-0	0-0

ND: Not Detected

Table 2: Profiles of Fatty Acids of Sheanuts and Butter

FATTY ACIDS PROFILE ¹⁶		
1.	Methyl myristate (C14:0) (%)	0.014 -0.0275
2.	Methyl myristoleate (C14:1) (%)	
3.	Methyl pentadecanoate (C15:0) (%)	0.005 -0.010
4.	Methyl palmitate (C16:0) (%)	0.662-2.636
5.	Methyl palmitoleate (C16:1) (%)	0.023-0.233
6.	Methyl heptadecanoate (C17:0) (%)	0.027-0.043
7.	Methyl stearate (C18:0) (%)	6.295-15.924
8.	Methyl oleate (C18:1) (%)	1.91-5.766
9.	Methyl linolenate (C18:3) (%)	
10.	Methyl linoleate (C18:0) (%)	0.21-0.281
11.	Methyl arachidate (C20:0) (%)	0.26-0.749
12.	Methyl eicosadienoate (C20:2) (%)	0.023-0.072
13.	Methyl eicosatrienoate (C20:3) (%)	0.107-0.122
14.	Methyl eicosanoate (C20:1) (%)	0.37-0.153
15.	Methyl arachidonate (C20:4) (%)	0.004-0.056
16.	Methyl behenate (C22:0) (%)	0.025-0.067
17.	Methyl erucate (C22:1) (%)	0.009-0.0110
18.	Methyl lingnocerate (C24:0) (%)	0.015-0.0325
19.	Methyl mervonate (C24:1) (%)	

Table 3: Summary of Means of Characteristics of Sheanut By Producing States Stream 1 (Batch A)

s/n	PARAMETERS	EXPECTED (Units)	STATES							
			NIGER		KEBBI		KWARA		OYO	
			AV	RANGE	AV	RANGE	AV	RANGE	AV	RANGE
1	Moisture ¹	(%)	3.45	2.69 - 4.22	3.41	2.94 - 4.10	3.21	3.19 - 3.22	3.64	3.32 - 4.06
2	Ash ²	(%)	2.95	2.66 - 3.29	2.74	2.41- 2.97	3.19	3.05 - 3.33	2.79	2.19 - 3.12
3	Calcium ³	(mg/kg)	1.34	0.99 - 1.99	1.74	1.70 - 1.78	4.03	2.22 - 5.84	4.0	1.57 - 6.42
4	Magnesium ³	(mg/kg)	1.91	1.33 - 3.68	2.53	1.69 - 3.38	1.62	1.62	1.06	0.50– 1.62
5	Iron ³	(mg/kg)	0.33	0.24 - 0.41	0.31	0.29 - 0.33	0.32	0.31 - 0.33	0.37	0.26 - 0.37
6	Lead ³	(mg/kg)	ND		ND		ND		ND	
7	Cadmium ³	(mg/kg)	ND		ND		ND		ND	
8	Total Aflatoxin ⁴	(µ/kg)	20%*	0.05	66%	0.05 - 1.00	ND	-	66%	0.40 - 0.69

*%: Percentage Occurrence

ND: Not Detected

Table 4: Summary of Means of Characteristics of Shea butter by Producing States Stream 1 (Batch A)

s/n	PARAMETERS	EXPECTED (Units)	STATES							
			NIGER		KEBBI		KWARA		OYO	
			AV	RANGE	AV	RANGE	AV	RANGE	AV	RANGE
1	Moisture ¹	(%)	2.26	0.02 – 8.21	2.20	0.53 – 3.86	0.20	0.17 - 0.22	2.57	0.4 - 4.71
2	FFA (as Oleic) ⁶	8 (%) max	5.3%	2 – 8.6	8.9	8.6-9.2	4.55	4.5-4.6	5.85	4.2-7.5
3	Sapon. Val ⁷	170-190 (mgKOH/g)	181.2	175.31-186.53	173.91	same	176.72	0-176.72	177.42	172.51- 182.33
4	Peroxide Value ⁸	10 (mEq/Kg)	5.2	2.0-7.2	4.6	4.4-4.8	3.4	3.2-3.6	6.0	5.2-6.8
5	Iodine Value ⁹	50-60 (WIJ's)	54.58	52.13-56.36	54.79	54.1-55.47	55.23	55.11-55.34	54.39	51.1-57.68
6	Melting Point ¹⁰	30-40 (°C)	34.7	32-37	33	28-38	31.5	31-32	34.5	34-35

%*: Percentage Occurrence

ND: Not Detected

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Table 5: Summary of Means of Characteristics of Sheanut By Producing States Stream 2 (Batch B)

s/n	PARAMETERS	EXPECTED (Units)	STATES							
			NIGER		KEBBI		KWARA		OYO	
			AV	RANGE	AV	RANGE	AV	RANGE	AV	RANGE
1	Moisture ¹	(%)	5.18	3.49 - 6.87	4.73	4.42 - 5.05	3.96	3.83 - 4.09	5.01	4.66 - 5.35
2	Ash	(%)	2.90	2.2 - 3.59	2.40	1.99 - 2.80	3.17	3.11 - 3.22	2.28	2.17 - 2.39
3	Zinc ³	(mg/kg)	0.21	0.12 - 0.30	0.23	0.2 1- 0.25	0.38	0.25-0.50	0.19	0.16 - 0.21
4	Copper ³	(mg/kg)	0.02	0.01 - 0.03	0.02	0.01 - 0.02	0.013	0.003- 0.023	0.02	0.004 - 0.035
5	Calcium ³	(mg/kg)	11.21	6.75- 15.66	16.46	13.48- 19.43	11.64	10.07- 13.21	13.72	9.80- 17.64
6	Magnesium ³	(mg/kg)	1.38	1.33 - 1.42	1.37	1.36 - 1.38	1.41	1.38 - 1.44	1.38	1.36 - 1.40
7	Iron ³	(mg/kg)	0.39	0.22 - 0.56	0.81	0.46 -1.16	0.36	0.28-0.47	0.42	0.30 - 0.53
8	Lead ³	(mg/kg)	ND		ND		ND		ND	
9	Cadmium ³	(mg/kg)	ND		ND		ND		ND	
10	Total Aflatoxin ⁴	(µ/kg)	100%*	0.3 - 0.9	100%	0.6 - 0.7	100%*	0.2 - 0.7	100%*	0.3 - 0.6
11	Oil Content ⁵	> 45 (%)	52.16	43.0- 61.32	55.49	54.2- 56.78	54.59	51.9- 57.28	62.02	58.63- 65.4
12	FFA (as Oleic) ⁶	8 (%) max	50%*	4.0 - 10.6	100%*	11.1 - 13.6	0%	5.0 - 6.2	66%*	7.5 - 9.9
13	Sapon. Value ⁷	170-190	176.5	171 - 182	183	178 - 188	185.13	185.13-185.13	175.5	171 - 180

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	(mgKOH/g)									
14	Peroxide Value ⁸	10 (mEq/Kg)	4	2.2 - 5.8	8.3	7.8 - 8.8	5.9	5.8 - 6.0	5.8	3.6 - 8
15	Iodine Value ⁹	50-60 (WIJ's)	51.92	50.0-53.84	55.46	53.8- 57.11	57.30	56.3- 58.3	55.72	54.33-57.11
16	Melting Point ¹⁰	30-40 (°C)	31.5	30 - 33	33	32 - 34	33.5	32 - 35	33.5	32 - 35
17	Organochlorine ¹¹	(%)	ND		ND		ND		ND	
18	Organophosphate ¹¹	(%)	ND		ND		ND		ND	
19	Aerobic Count ¹²	10000(cfu)	3170	140 - 6200	1780	980- 2580	760	570 - 950	635	180 - 1090
20	Mould Count ¹³	500(cfu)	460	280 - 640	210	40 - 380	305	140 - 470	515	210 - 820
21	Coliform Count ¹⁴	100(cfu)	864	128 - 1600	135	0- 270	195	70 - 320	75	0 - 150
22	E. coli ¹⁵	0(cfu)		0		0		0		0

%*: Percentage Occurrence; ND: Not Detected

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Table 6: Summary of Means of Characteristics of Sheabutter by Producing States Stream 2 (Batch B)

s/n	PARAMETERS	EXPECTED (Units)	STATES							
			NIGER		KEBBI		KWARA		OYO	
			AV	RANGE	AV	RANGE	AV	RANGE	AV	RANGE
1	Moisture ¹	(%)	0.31	0.028-058	0.92	0.19-0.93	1.28	0.40-2.17	0.82	0.459-1.18
2	Ash ²	(%)	-	-	-	-	-	-	-	-
3	Zinc ³	(mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND
4	Copper ³	(mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND
5	Calcium ³	(mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND
6	Magnesium ³	(mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND
7	Iron ³	(mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND
8	Lead ³	(mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND
9	Cadmium ³	(mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND
10	Total Aflatoxin ⁴	(µ/kg)	ND	ND	ND	ND	ND	ND	ND	ND
11	FFA (as Oleic) ⁶	8 (%) max	3.9	1.4-6.4	5.65	3.5-7.8	6.5	6.2-6.8	4.8	4.6-5.0
12	Sapon. Val ⁷	170-190 (mgKOH/g)	180.23	171.11-189.34	180.93	176.72-185.13	180.93	179.52-182.33	179.52	171.11-187.94
13	PeroxideValue ⁸	10 (mEq/Kg)	3.5	1.2-5.8	7.8	5.8-9.8	2.6	1.4-3.8		2.6-4.4

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s/n	PARAMETERS	EXPECTED (Units)	STATES							
			NIGER		KEBBI		KWARA		OYO	
			AV	RANGE	AV	RANGE	AV	RANGE	AV	RANGE
14	Iodine Value ⁹	50-60 (Wij's)	52.40	50.04-54.75	50.77	50.4-51.15	50.95	50.76-51.13	50.39	50.01-51.12
15	Melting Point ¹⁰	30-40 (°C)	34	28-40	36	30-42	33	31-35		28-40
16	Organochlorine ¹¹	(%)	ND	-	ND	-	ND	-	ND	-
17	Organophospate ¹¹	(%)	ND	-	ND	-	ND	-	ND	-
18	Aerobic Count ¹²	10000(cfu)	690	120 -1260	95	30-160	470	110 - 830	240	60 - 420
19	Mould Count ¹³	500(cfu)	65	10 - 120	90	20-160	110	60 -1 60	80	30 - 130
20	Coliform Count ¹⁴	100(cfu)	0		0		13.5	1-26	0	
21	E. coli ¹⁵	0(cfu)	0		0		0		0	

ND: Not Detected

1.4. DISCUSSIONS

1.4.1. Moisture Content:

The moisture content was in the range of 2.69 to 6.87% and 0.026 to 2.17 % for sheanut and shea butter respectively (Table 1). The average moisture level of both products did not differ significantly across the shea nut/butter producing states

1.4.2. Ash content:

The ash content of the shea nuts ranged from 1.99 - 3.59% between the producing States. The average % ash content value obtained for each of the 4 producing states also do not differ significantly indicating that the level of inorganic components of the soil are very similar (Table 5).

1.4.3. Trace Metals:

Table 1: 3-9 indicate the trace/heavy metals results of the products. The levels of trace and heavy metals obtained for shea nuts across the four producing states showed very close similarity.

Analyses showed that sheanut across the producing states contain Zinc (Zn) in the range of 0.12 - 4.06 mg/kg with a mean value of 0.25%.

The Copper (Cu) content ranged from 0.004 - 0.04 mg/kg with a mean value of 0.02% ;

Calcium (Ca) content ranged from 6.75 - 19.43mg/kg ;

Magnesium (Mg) content in sheanut ranged from 1.33 – 1.44mg/kg;

Iron (Fe) content ranged from 0.24 - 1.44mg/kg.

Lead (Pb) and Cadmium (Cd) were not detected.

None of the above trace metals were detected in shea butter from the qualitative test (Reinsch) performed.

1.4.4. Oil Content:

The oil content obtained for shea nut ranged from 43.0 - 65.4% .The expected oil content is 45% and above (Table 1: 11).

1.4.5. Free Fatty Acid-

The level of FFA, a degradation/spoilage indication of the products showed about 54% of the sheanut and shea butter samples above the permissible level of 8% for Free Fatty Acid (as Oleic). The FFA content of shea nut ranged from 4.0 - 13.6% while that of shea butter was between 1.4 - 7.8 (Table 1: 12)

1.4.6. Saponification value

Table 1: 13 shows that the saponification value of fat extract from shea nuts ranged from 171 - 188 mgKOH/g and sheabutter 171.11- 189.34mgKOH/g (expected: 170 and 190mgKOH/g.)

1.4.7. Peroxide Value:

The values obtained for peroxide values of shea nuts and shea butter from the 4 producing states indicate good storage practices. In shea nut the values ranged from range of 2.2 - 8.8mEq/kg and 1.2 - 9.8mEq/kg for shea butter (the expected value is10mEq/kg). (Table 1:14)

1.4.8. Iodine value:

This is a measure of the degree of unsaturation and is a useful parameter for identifying oils. The fat extract of the shea nuts had values ranging from 50 - 57.11 and shea butter ranged from 50.01- 54.75 (expected- 50-60 Wij's.), (Table 1:15)

1.4.9. Melting Point-

This is useful in the identification and composition of fats and also for the establishment of storage temperature. The expected melting point range for the products is between 30 - 40°C. Fat extracts of the shea nuts had a melting point range of 30 - 35°C with shea butter ranging between 28 - 41°C. (Table 1: 16).

1.4.10. Total Aflatoxins:

There was 100% occurrence of Aflatoxins in all the sheanuts samples. The total Aflatoxins detected in sheanut ranged from 0.05 - 1.0 ug/kg (Table 1:10) however the mean values of total Aflatoxins were below Maximum Residue Limit of 10ug/kg.

1.4.11. Pesticides Residues:

Organochlorine and organophosphate pesticides residues were not detected in any of the products. This confirms open cultivation of shea tree in Nigeria. This scenario may be further explored in establishing natural or organic production claims for the trees' products. (Table 1: 17&18)

1.4.12. Microbiological Analysis:

The total aerobic mesophilic bacteria count in sheanut and sheabutter ranged from 140 - 6200 and 30 - 1260 respectively, the expected limit being 10000cfu.

The mould count in shea nuts and shea butter across the 4 producing states ranged between 40-820cfu and 10 – 120 cfu indicating 67% to 100% of occurrence in the samples analysed. The maximum limit for mould count is 500 cfu. The relatively higher levels recorded for shea nuts may be indicative of storage conditions and processing practices. However further processing could be responsible for reduction of mould count noticed in shea butter.

Coliform Count: All the samples had an excessive coliform count (limit 100cfu) an indication of serious microbial contamination, with average count in sheanut ranging from 0- 1600cfu and 60-160 cfu in sheabutter. *E.coli* was however not detected in any of the products across the states.

The microbial results in the second stream samples (Table 4) when compared with first stream (Table 3) showed that season of sampling may play a significant role in characterising safety parameters of sesame seed and shea nuts. Nigeria has basically two climatic seasons: dry and wet season. First Stream (Table 2), which featured lesser microbial count, was sampled during dry season and Second Stream was sampled during wet season. However the inorganic parameters remain fairly constant. This shows the importance of handling practices and timing in establishing good qualities of shea produce from Nigeria

1.4.13. Fatty acid profile:

The composition of fatty acids in the shea nut and shea butter is outlined in Table 2. The dominant fatty acid in shea butter being Methyl stearate (C18:0) 6.3-15.9%, Methyl palmitate (C16:0) 0.7-2.6% and Methyl oleate (C18:1) 1.9-5.8 %. The result of fatty acids profile of shea nuts and butter was delayed because of equipment challenges.

1.5 OBSERVATION

While inadequacy of samples did not afford detailed analyses of the First Stream of Samples, the results of total aflatoxins tests captured in both Streams 1 and 2 present an interesting result. The expectation is that with better sampling procedure given to the Field Officers (Appendix 1), lower records of Aflatoxin incidences would be expected in the second stream. The contrary was the case; lower percentages of incidences (20%, 66%, 66% and even ND in one sample) were recorded in Stream 1 (Table 3), while in Stream 2 (Table 5), 100% incidences were recorded throughout.

The advent of raining season could be a factor. This is bearing in mind that the first set of samples were taken in April and submitted early May while the second set of sample was taken in late June at the peak of rain. Polluted source of water could be a factor.

2.5 REFERENCES

- ¹ AOAC. Official Methods of analysis (method page 1, 40.1:04, 2005)
- ² AOAC. Official Methods of analysis (method 40.1.08 2005)
- ³ AOAC. Official Methods of analysis (method 991.11, 2005)
- ⁴ AOAC. Official Methods of analysis (method 999.07, 49.2.29, 2005)
- ⁵ AOAC. Official Methods of analysis (method 945.16, 1990)
- ⁶ AOAC. Official Methods of analysis (method 940.28, 41.1.21, 2005)
- ⁷ AOAC. Official Methods of analysis (method 920.160, 41.1.18 2005)
- ⁸ AOAC. Official Methods of analysis (method 965.33, 41.1.16, 2005)
- ⁹ AOAC. Official Methods of analysis (method 920.159, 2000)
- ¹⁰ AOAC. Official Methods of analysis (method 920.157, 41.1.09, 2005)
- ¹¹ QuEChERS Method, EN15662.2007
- ¹² ISO 4833:2003
- ¹³ ISO 21527-2 2008
- ¹⁴ ISO 4832:2006
- ¹⁵ ISO 16649-2:2001
- ¹⁶ AOAC. Official Methods of analysis (method 969.33- 2005)

APPENDIX 1

**PROVISIONAL SAMPLING GUIDE FOR CHARACTERISATION OF SESAME SEEDS AND
SHEANUTS/BUTTER**

(Instructions for taking, preparing and packaging the samples)

Preamble: The purpose for this sampling guide is to assist the field inspectors and other ad hoc staff in the WTO STDF Project 172 on Sesame seed and Sheanut/Butter in Sampling, Packaging, Handling and Safe Delivery of Samples to the testing laboratory(ies) for the characterization study.

Sampling Size: 500g to 1 Kg

Packaging: Preferably wide mouthed glass bottle with screw cap.

Labelling: The sample bottle must be labeled containing the following information

Name/Type of Sample:

Sampling Location:

Sample No/Code:

Time of collection:

Temperature at collection:

Humidity at collection:

Sampling By: (Name and Signature)

Date of sampling:

Sample sent thru:

Date of Dispatch

Transportation: By road, air, rail, etc.

Storage Conditions: Dry, Cool, avoid excessive heat.

EXPANDING EXPORT OF SESAME SEED AND SHEANUT/BUTTER THROUGH IMPROVED SPS CAPACITY BUILDING FOR PUBLIC AND PRIVATE SECTOR

This document presents the *“Physico-Chemical Characterisation of Shea Nuts and Shea Butter in Nigeria”*

This document has been prepared in consultation with several sector stakeholders, NEPC and by:

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