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Effect of fermentation on the nutritional potential of oils of melon seeds

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ABSTRACT

The nutritional potential of oils extracted from different melon seeds and their fermented products-'ogiri' was investigated. Diets composed with the oils were fed to experimental animals (albino rats) for seven weeks, while soybean oils served as control. Nutritional qualities were compared on the basis of the responses of body weight, organ weight, and biochemical parameters of the oils. The rats fed on diets with oil from fermented melon seeds gained more weight (28.30 – 43.24g) than those in the diet groups containing oil from unfermented seeds (27.74-31.98g). However, the differences were not significant at $p \leq 0.5$. The relative weights of the hearts of rats fed on unfermented oil diets were higher than the corresponding fermented diet groups. The relative kidney and liver weights of the test diets were higher than the control diet, except diet containing oil from unfermented *Citrullus lanatus* (UCL). Both acid phosphates (ACP) and alkaline phosphates (ALP) in the test groups were higher than in the control group. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were reduced in the liver of the text groups in the group fed with diet containing oil of unfermented *Cucumeropsis manii* (UCM). AST increased in the hearts of the text groups except UCM. In summary, oils from fermented melon seeds were nutritionally better than oils from unfermented melon seeds.

Key words: Melon seeds, fermentation, nutrition, 'ogiri', transferase, phosphates.

INTRODUCTION

Melon seeds, amongst other oils seeds (Jideani and Okeke, 1991) are used to produce 'ogiri' especially in the South-West Nigeria (Odunfa, 1981a). Fermented melon seed is used as soup condiment by rural dwellers. Ogiri production, a traditional family art, is by chance inoculation fermentation (Odunfa, 1981b).

The chemical composition of five types of melon seeds had an average of 53.00% lipid (Oyolu, 1977). The fatty acid composition of oil from melon seeds has been reported to be similar to that of soybean; and both possess high percentage of linoleic acid (Alfin-Slater and After gold, 1969). The contribution of plant lipids which could meet the fatty acid requirements of animals has been recognized for long. These plant lipids are very rich in essential fatty acids (Holman, 1981). The ingestion of raw oil seeds by rats had no significant effect on feed intake, but caused growth inhibition (Odutuga and Oloyede, 1992). The addition of lipids to a 19.00% protein diet increased growth in chicks (Endozien and Switzer, 1977); while the fat-free diets grew more slowly and reached the weight plateau very early in life (Alfin-Slater and After gold, 1969). Consumption of fat diets has important function in the body of animals (Salim *et al.,* 2002). Epidemiological studies have shown that dietary factors are the most important environmental risk determinants for human (Jelinsa *et al.,* 2003).

Lipids of both fermented and unfermented melon seeds could produce effects in experimental animals Thus the aim of this research work is to assess the effect (s) of fermentation on the nutritional potentials of oils in three types of melon seeds that could be used to produce 'ogiri'.

MATERIALS AND METHODS

Collection of samples

Three different types of shelled melon seeds: "Ito" (*Cucumeropsis Manii* Naud), 'Bara' (*Citrullus lanatus* L.), and 'Sewere' (*Citrullus vulgaris* Shard) were purchased at Bodija Market in Ibadan, Nigeria. The seeds were sorted out to remove grit, dirt, and decomposing seeds, washed and boiled for one hour in 10 times its volume of water. The boiled water was drained and replaced with cold water and boiled for six hours of softness. The melon seeds were transferred into a clay pot and covered with *Thaumatococcus danielii* and wrapped in sack cloth for five days. The fermented product was then ground to a pulp with mortar and pestle (Omafuvbe *et al.,* 2004).

Soybean meal, which was used as the source of protein, was obtained from the JOF Ideal Industry, Owo, Nigeria.

Source of experimental animals

Thirty five (35) four weeks-old female weanling albino Wistar rats were obtained form the Preclinical Animal House of the University of Ibandan, Nigeria. The animals were acclimatized for five days and fed with grower's mash and adequately supplied with distilled water. The animals were assigned into cages and randomly distributed into seven treatment groups. The rats were maintained under standard conditions of temperature and humidity and starved overnight before appropriate composed diets were administered.

Extraction of oil from melon seeds

Both fermented and unfermented melon seeds were submerged in the solvent, the mixture was thoroughly mixed and decanted into different beakers as described by Adisa and Odutuga, (1981). The mixture was separated by evaporation in the water bath.

Composition of diets

The composition of test diets differed only in the lipid supplement but each diet contained the same volume of appropriate. Vitamin and minerals mixture was done in ratio 1 to 4. The mixture contained (g/kg diets): thiamine (0.02), riboflavin

Table - 1: Percentage composition of experimental diets (g/100g)

Component	Diet groups						
	UCM	FCM	UCL	FCL	UCV	FCV	Control
Corn starch	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Sucrose	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Protein	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Vitamins & minerals	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Cellulose	4.00	4.00	4.00	4.00	4.00	4.00	4.00
OUCM	8.00	-	-	-	-	-	-
OFCM	-	8.00	-	-	-	-	-
OUCL	-	-	8.00	-	-	-	-
OFCL	-	-	-	8.00	-	-	-
OUCV	-	-	-	-	8.00	-	-
OFCV	-	-	-	-	-	8.00	-
SBO	-	-	-	-	-	-	8.00

OUCM and OFCM are oils from unfermented and fermented *Cucumeropsis manii* respectively.
OUCL and OFCL are oils from unfermented and fermented *Citrullus lanatus* respectively.
OUCV and OFCV are oils from unfermented and fermented *Citrullus vulgaris* respectively.
SBO is soy-bean oil (Control)

(0.03), pyridoxine (0.10), vitamin B_{12} (0.00003), niacin (0.001), calcium pantothenate (0.10), p-aminobenzoic acid (0.01) Vitamin A acetate (0.04), ergocalciferol (0.4) and choline-HCl (2.0). Minerals mixture contained (g/kg diet) $CaCO_3$ (15.56) $CaCl_2.6H_2O$ (0.001), $CuSO_45H_2O$ (0.019), $FeSO_4.7H_2O$ (1.078), $MgSO_4$ (2.292), and $MnSO_4.2H_2O$ (0.025). The diet were composed as shown in Table 1. The feeding experiment lasted for seven weeks.

Determination of absolute weight and relative organ weight

The weight of each rat in the diet groups was taken, with sensitive balance, and recorded twice a week. The difference between the initial and the final weight was taken to be the weight gained by the rat. The average weight gained by the rats in each diet group was determined. The rats were anaesthetized with chloroform on the last day of the experiment. The body cavity was opened and different organs: heart, kidneys and liver were carefully removed, rinsed in 0.25 M sucrose solution, and weighed.

The relative organ weight was determined thus:

$$\frac{\text{Weight of the organ (g)}}{\text{Total weight of the rat (g)}} \times \frac{100}{1}$$

Preparation of homogenates and enzyme assay

The organs were homogenized separately in 0.25 sucrose in ratio 1 to 4. The homogenates were kept immediately in the refrigerator at 4°C until use. The homogenates were used in determination of enzyme activities in the organs.

The method of Bergermeyer and Bret (1974) was used in the determination of the alkaline phosphates (ALP) and acid phosphates (ACP). The Randox® enzyme kits were used to determined the activities of Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT).

Statistical analysis

The results are expressed at means ± standard error of means (SEM). The data were analyzed using the Statistical Package for Social Scientists (SPSS, version 11). Any significant difference between the values was assessed at 99.95% level of significance (i.e. $p \leq 0.05$).

RESULTS AND DISCUSSION

Table 2 shows the responses of the rats to the composed diets. The final weights of the rats ranged between 76.24g and 97.33g. At the end of the feeding experiment, the test diets had lower body weight gain compared to the control; though

Table - 2 : Performance of rats fed fermented and unfermented melon oil diets (means ± SEM in gram)

Diets	Initial weight	Final weight	% increase
UCM	47.68 ± 3.02	76.24 ± 6.88	59.90
FCM	50.06 ± 3.91	93.3 ± 5.61	86.38
UCL	48.92 ± 4.76	76.66 ± 2.94	54.66
FCL	52.42 ± 1.56	81.72 ± 2.70	58.93
UCV	48.46 ± 3.59	80.44 ± 4.63	65.99
FCV	52.10 ± 2.87	85.42 ± 2.35	63.95
SO	49.00 ± 4.56	97.33 ± 4.09	108.83

UCM and FCM are diets containing oils from unfermented and fermented *Cucumeropsis manii* respectively.
UCL and FCL are diets containing oils from unfermented and fermented *Citrullus lanatus* respectively.
UCV and FCV are diets containing oils unfermented and fermented *Citrullus vulgaris* is respectively.
SO is control diet containing soy-bean oil

the difference was not significant ($p \leq 0.05$). The diet containing oil from fermented *Cucumeropsis manii* (FCM) had the highest percentage increase of 84.38%, while UCL had the least value of 54.66% among the test diets. The test oils (fermented and unfermented) supported the growth of the rats, though at varying degrees. Except for *Citrullus vulgaris*, it was observed that oils from fermented melon seeds gave higher percentage increase in body weight than their corresponding unfermented samples. Based on the final body weight, the qualities of the tested oils were lower compared to the control. It had been reported that poor quality of oil impedes the nutritional benefits (weight gain and stability of the appetite) anticipated of animals that are continuously supplied with food and water (Aniagu, *et al.,* 2005).

There was no significant difference ($p \leq 0.05$) in the relative heart weight of the rats table 3. Unfermented melon seeds induced larger hearts in the rats than the fermented melon seeds except for *C. vulgaris*. Fermented samples had higher values of relative kidney weights than the unfermented samples. Diet groups UCM, UCV and FCV had higher relative liver weight that the control

Table - 3: Relative weight of the organ of experimental rats fed different oil diets (mean±SEM).

Diets	Weight (g)	Heart Relative weight	Weight (g)	Kidney Relative weight	Weight (g)	Liver Relative weigth
UCM	0.434±0.019	0.489	1.020±0.076	1.150	4.237±0.441	4.778
FCM	0.376±0.925	0.478	0.909±0.073	1.156	4.266±0.431	5.375
UCL	0.376±0.010	0.463	0.684±0.015	0.809	2.920±0.671	3.452
FCL	0.348±0.024	0.460	0.798±0.063	1.054	3.961±0.287	5.231
UCV	0.439±0.055	0.489	1.033±0.128	1.151	4.524±0.755	5.039
FCV	0.427±0.035	0.501	0.975±0.166	1.155	4.051±0.866	4.800
SO	0.494±0.015	0.480	0.947±0.920	0.078	3.656±0.169	3.552

UCM and FCM are diets containing oils from unfermented and fermented *Cucumeropsis manii* respectively.
UCL and FCL are diets containing oils from unfermented and fermented *Citrullus lanatus* respectively.
UCV and FCV are diets containing oils from unfermented and fermented *Citrullus vulgaris* respectively.
SO is control diet containing soy-bean oil

Table - 4: Enzymatic activities in the kidney of rats fed different oil diets (means ± SEM I.U/L).

Diets	ACP	ALP	AST	ALT
UCM	69.40 ± 1.47	552.00 ± 5.86	177.20 ± 5.40	24.00 ± 1.87
FCM	98.81 ± 5.08	500.90 ± 38.54	241.00 ± 5.70	44.00 ± 2.65
UCL	173.13 ± 6.92	256.65 ± 7.73	199.60 ± 4.83	73.60 ± 2.41
FCL	47.40 ± 2.73	251.03 ± 9.36	204.00 ± 3.87	35.60 ± 2.30
UCV	99.34 ± 7.20	89.80 ± 4.86	189.60 ± 5.77	19.80 ± 2.95
FCV	76.53 ± 4.39	626.53 ± 13.87	243.40 ± 9.24	28.60 ± 5.32
SO	92.05 ± 2.93	855.60 ± 13.67	167.80 ± 4.92	36.20 ± 3.49

UCM and FCM are diets containing oils from unfermented and fermented *Cucumeropsis manii* respectively.
UCL and FCL are diets containing oils from unfermented and fermented *Citrullus lanatus* respectively.
UCV and FCV are diets containing oils from unfermented and fermented *Citrullus vulgaris* respectively.
SO is control diet containing soy-bean oil
AST is Aspartate aminotransferase and ALT is Alamine aminotransferase

Table -5: Enzymatic activities in the heart of rats fed different oil diets (mean ± SEM I.U/L.).

Diets	ACP	ALP	AST	ALT
UCM	17.80 ± 0.07	187.23 ± 7.95	194.60 ± 3.36	95.00 ± 2.83
FCM	35.33 ± 0.85	121.60 ± 4.65	164.00 ± 11.56	53.80 ± 5.12
UCL	35.28 ± 2.39	17.73 ± 0.05	122.28 ± 5.40	33.80 ± 5.40
FCL	14.78 ± 0.03	17.10 ± 1.42	174.40 ± 7.06	44.00 ± 3.24
UCV	37.83 ± 2.84	137.30 ± 3.84	177.20 ± 7.26	43.80 ± 3.97
FCV	35.80 ± 3.14	16.78 ± 2.19	195.40 ± 3.05	35.40 ± 3.97
SO	57.78 ± 4.36	151.40 ± 16.23	168.00 ± 6.44	75.80 ± 6.88

UCM and FCM are diets containing oils from unfermented and fermented *Cucumeropsis manii* respectively.
UCL and FCL are diets containing oils from unfermented and fermented *Citrullus lanatus* respectively.
UCV and FCV are diets containing oils from unfermented and fermented *Citrullus vulgaris* respectively.
SO is control diet containing soy-bean oil
AST is Aspartate aminotransferase and ALT is Alamine aminotransferase

Table -6: Enzymatic activities in the liver of rats fed different oil diets (mean ± SEM I.U/L.).

Diets	ACP	ALP	AST	ALT
UCM	123.75 ± 8.29	256.15 ± 6.85	189.60 ± 9.24	158.80 ± 6.53
FCM	356.50 ± 16.06	131.28 ± 11.36	185.40 ± 13.97	100.60 ± 5.46
UCL	148.96 ± 4.21	218.18 ± 3.34	156.00 ± 5.48	75.60 ± 6.80
FCL	166.80 ± 4.19	269.75 ± 8.88	187.20 ± 3.89	99.12 ± 9.09
UCV	284.48 ± 7.45	224.30 ± 2.54	224.60 ± 5.32	101.80 ± 7.81
FCV	324.78 ± 5.40	100.78 ± 6.43	178.40 ± 8.82	78.80 ± 8.29
SO	183.92 ± 12.95	384.98 ± 12.21	229.40 ± 6.23	129.00 ± 2.65

UCM and FCM are diets containing oils from unfermented and fermented *Cucumeropsis manii* respectively.
UCL and FCL are diets containing oils from unfermented and fermented *Citrullus lanatus* respectively.
UCV and FCV are diets containing oils unfermented and fermented *Citrullus vulgaris* is respectively.
SO is control diet containing soy-bean oil
AST is Aspartate aminotransferase and ALT is Alamine aminotransferase

diet. Rats fed UCL diet had lower relative kidney (0.809 and 3.452 respectively) than the control diet. The significant increase in the relative organs weight of the test groups reveals the possible toxic effect of the oil to the organs (Aniagu, et al., 2005).

Tables 4-6 shows the enzymatic activities in the organ of the experimental animals. ALP is a plasma membrane bound enzyme while ACP is of lysosomal origin. Dietary lipids have been known to regulate membrane lipid composition, which in turn controls the activity of the membrane proteins (Sergio *et al.,* 2003). The ACP and ALP appeared low in the organs (heart, kidney and liver) of the test groups than the control. The effect was more pronounced in the fermented oil diets. The reduced activities of ACP an ALP observed in this study could be due to leakage of enzymes into serum. This implies that the quality of the oil affected the structural integrity of the membrane.

Transaminases are widely distributed in animal tissues. The transamination reaction catalyzed by AST and ALT is essential for the protein synthesis in the liver (Nelson and Cox, 2002). Test groups had increased amount (compared with the control) of AST in the hearts, except UCL and FCM. The UVM diets group had the highest value of ALT. In the three organs, the amount of AST was higher than ALT; which agrees with this supports the finding

of Mayne, (1996), who reported that the body cells contain more AST than ALT. Decreases in ALT, as recorded in UCV and UCM (in the kidney) and in FCM, UCL, FCL, UCV and FCV (in the heart) could be due to leakage into extra cellular fluids. This could have adverse effect on protein synthesis and hence affect the cellular metabolism (Al-Attar, 2004).

In conclusion, our study indicates that both fermented and unfermented melon seed oil have divergent effect on the rats; however the fermented oils from fermented melon seed appear to be nutritionally better than the corresponding unfermented melon seed oil.

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