EFFECT OF PALM OIL SUPPLEMENTATION ON CARCASS YIELD AND FATTY ACID COMPOSITION OF GROWING RABBITS.

***G.T.IYEGHE-ERAKPOTOBOR, T.E.EKPEYONG AND *R.O.BALOGUN**

Department of Animal Science, University of Ibadan, Ibadan

**National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria.*

Received 02 November 1996; Accepted 23 May 1997.

ABSTRACT

A 12 week feeding trial was conducted to evaluate the effect of palm oil (PO) supplementation at 0% (control), 3% or 5% levels on carcass yields and fatty acid composition of organs of growing rabbits. Results obtained showed that palm oil supplementation did not significantly affect ($P > 0.05$) carcass and organ yields. Percent analysis however showed that in the heart, myristic acid was highest in the control diet (78.58%), lauric acid in 3% PO (41.56%) and stearic acid in 5% PO (84.43%) groups. In the kidney, there was increased level of palmitic (1.30-57.06%) but decreased levels of myristic (43.41 - 0.51%) and oleic acids (9.26 - 8.08%). There were detectable levels of caprylic, linoleic and arachidonic acids in rabbits fed PO diets compared to none in the control group. On the other hand, there were detectable levels of stearic and lauric acids in the control group but none in the PO groups. In the liver, only lauric, stearic and myristic acids were detected, with the latter not detected in the liver of control group. Three rabbits on the control diet died as a result of septicaemia. It was concluded from this study that PO seemed to affect organ fatty acid composition but not on weight of organs. The effect on fatty acid composition was however, not consistent.

Key words: Rabbit, palm oil, carcass, organs, fatty acid.

INTRODUCTION

Fats are essential in ensuring adequate utilisation of nutrients for growth and reproduction (Sell and Owings, 1981; Beynan, 1988). Fats could reduce intake but at the same time increase rate of weight gain (Eshielt *et al.*, 1979; Iyeghe and Ekpenyong, 1990). Other

advantages of fats in the diets include enhancing the absorption of vitamin A, sparing action on vitamin D and development of immune response (Jezkova and Petz, 1976).

Oils of different types are good sources of fat and type of dietary fat have been shown to influence performance of rabbits (Beynan, 1988; Iyeghe and Ekpenyong, 1990). Apart from their high content of fats, oils are also good sources of high energy in the diet. High concentration of energy in the diet of rabbits increases the caloric density of the diet (Sell and Owings, 1981) and could increase carcass and organ yields or affect the fatty acid composition of tissues and organs in the body. Eshielt *et al.*, (1979) reported slight increase in carcass yield and reduction in kidney and liver weights with increase in energy concentration of rabbit diet. Changes in organ fatty acid composition vary with source of fat, level of fat, animal species and age (Williams *et al.*, 1968; Sabine *et al.*, 1969; Vodovar *et al.*, 1973; Bashid *et al.*, 1973; Dramer *et al.*, 1975; Puthzath and Alamela, 1977).

Palm oil is the cheapest and most readily available oil in Nigeria. It is higher in energy and fatty acids compared to other oils. It is also a good source of essential fatty acids, which are important in immune response (Jezkova and Petz, 1976). This study determined the effect of palm oil supplementation on carcass yield and fatty acid composition of growing rabbits in the humid tropics.

MATERIALS AND METHODS

This study was conducted at the University of Ibadan, Nigeria farm. Twenty four growing crossbred rabbits (average body weight of 540g) were bought from an open market and were randomly allocated to three treatment diets with palm oil (PO) supplementation at 0% (control), 3% or 5%. The feed and proximate composition of the experimental diets have been reported by

TABLE 1: COMPOSITION OF EXPERIMENTAL DIETS

Ingredient (g)	Palm oil supplementation (%)		
	0	3	5
Corn offal	19.99	46.35	64.60
Palm kernel meal	76.51	43.01	20.13
Bone meal	3.00	3.00	3.00
Palm oil	-	3.00	5.00
Blood meal	-	4.14	6.97
Salt	0.25	0.25	0.25
Vit/min/ premix*	0.25	0.25	0.25
Calculated composition:			
Energy (kcal ME/kg)	2313.50	2345.00	2365.00
Crude protein (%)	18.01	17.99	18.00
Crude fibre (%)	8.00	6.45	5.39

(Iyeghe and Ekpeyong, 1999)

*Contains per Kg; 3,000,000 IU vitamin A; 600,00 IU vitamin D₃; 4,000 mg vitamin E; 600 mg vitamin K₃; 1,200mg vitamin B₂; 2,000 mg vitamin B₃; 1.2mg vitamin B₁₂; 6,000mg niacin; 84,000 mg Chlorine; 24,000mg Mn; 800 mg Fe; 16,000mg Cu; 18,000mg Zn; 500mg Iodine; 48mg Se and antioxidant(BHT).

Iyeghe and Ekpeyong (1990) and is shown in Tables 1 and 2. Rabbits were kept in individual cages and experimental diets were fed once daily in the morning. Green forage was provided once daily, in the evening to all the experimental animals. Water was also provided ad libitum. One rabbit fed 5% PO diet died in the seventh week of this study as a result of paralysis from broken spine and subsequent urinary incontinence.

At the end of the 12 - week feeding period, two male rabbits from each treatment group were weighed and slaughtered. The rabbits were skinned and the carcass, liver, kidney, heart, head, intestines and skin weighed to determine their yields, expressed as percentage of the live-weight immediately before slaughter. The kidney, liver and heart were dried of blood with soft tissue paper, weighed and then stored until

required for extraction and analysis.

Extractions of total lipids in the various organs were carried out at the Nigerian Stored Products Research Institute (NSPRI), Ibadan, using the procedure of AOAC, 1985). Extraction was done for five hours using a mixture of methanol: chloroform (1:1 v/v) in a soxhlet apparatus, electrothermal extraction unit. Extracted lipids, in the mixture of methanol/chloroform were then stored in a deep freezer at a temperature of -12°C. Methylation and gas liquid chromatography (GLC) analysis was carried out at the Biochemistry Department of the Nigerian Institute for Oil Palm Research (NIFOR), Benin (James, 1960). Methyl esters were prepared by refluxing the lipids in a methanol: concentrated sulphuric acid mixture (9:1 v/v), in a sand bath for one hour. The mixture was allowed to cool slightly and poured into a fractionating flask and

TABLE 2: PROXIMATE COMPOSITION OF EXPERIMENTAL DIETS

Constituent(g/100g dry matter)	Diet		
	control	3% palm oil	5% palm oil
Dry matter	97.00	98.00	96.00
Crude fibre	6.18	10.20	15.62
Crude protein	19.12	19.02	17.87
Ether extract	1.03	4.08	6.25
Ash	9.79	9.59	10.10
Nitrogen free extract	63.88	57.11	50.16

IYEGHE AND EKPEYONG

Nigerian Journal of Animal Production 27(1) 2000:29-34

PALM OIL SUPPLEMENTATION FOR GROWING RABBITS

10 ml Hexane added. The mixture was shaken thoroughly and allowed to stand for 3 minutes. The methyl esters in hexane was collected and heated for 3 - 4 minutes. Onemg anhydrous Sodium sulphate (Na_2SO_4) was added to the methyl esters. This mixture was then passed through the GLC (model Pye 104), with the following setting: flow rate 35 ml/minute, flame ionization detector, 185°C, carrier gas nitrogen, hydrogen detector gas and compressed air for the column) to fractionate the various methyl esters present in the mixture. The various fatty acids present in each organ sample were obtained as peaks in the GLC.

Statistical analysis

The study was based on a completely randomised design. Analysis of variance procedure was used to detect the effect of diet on the carcass and organ yields (Steel & Torrie, 1960). Fatty acid composition in the organs

were not tested statistically due to inadequate organ samples. Rabbit organs had to be composited to obtain required quantity for lipid analysis. Results were therefore, analysed as percentages.

RESULTS AND DISCUSSION

Carcass and organ weights

Result of rabbit carcass and organ weights is shown in Table 3. There were increase or decreases in carcass or organ weights with PO supplementation but the differences were not significant ($P > 0.05$). When carcass and organ weights were expressed as a percentage of liveweight, there was no significant ($P > 0.05$) differences between treatments, although the intestinal (plus content) and carcass weights were slightly decreased and increased, respectively (Table 4). This observation agrees

TABLE 3: EFFECT OF PALM OIL SUPPLEMENTATION ON CARCASS AND ORGAN WEIGHTS OF GROWING RABBITS (GRAMS)

Parameter	Palm oil level*		
	0%	3%	5%
Skin	470	490	370
Liver	90	100	90
Heart	7	6	6
Kidney	20	20	20
Intestine + contents	870	680	670
Head	390	380	330
Carcass	1590	1950	1550

*Palm oil supplementation not significant ($P > 0.05$)

TABLE 4: EFFECT OF PALM OIL SUPPLEMENTATION ON PERCENTAGE CARCASS AND ORGAN WEIGHTS OF GROWING RABBITS (% OF BODYWEIGHT)

Parameter	Palm oil level*		
	0%	3%	5%
Skin	13.54	12.22	11.21
Liver	2.59	2.49	2.73
Heart	0.20	0.15	0.18
Kidney	0.58	0.50	0.61
Intestines + contents	25.07	16.95	10.00
Head	11.24	9.48	10.00
Carcass	45.82	48.63	46.97

*Palm oil supplementation not significant ($P > 0.05$).

TABLE 5: EFFECT OF PALM OIL SUPPLEMENTATION ON HEART, KIDNEY AND LIVER FATTY ACIDS COMPOSITIONS OF GROWING RABBITS (% OF TOTAL FATTY ACID)

Organ	Fatty acid	C atoms	Palm oil level		
			0%	3%	5%
Heart:	Caprylic acid	8:1	3.93	nd1	nd
	Lauric acid	12:0	3.74	41.56	13.46
	Myristic acid	14:0	78.58	45.90	2.11
	Palmitic acid	16:0	nd	7.48	nd
	Stearic acid	18:0	9.82	nd	84.43
	Oleic acid	18:1	3.93	3.12	nd
	Linoleic acid	18:2	nd	1.92	nd
Kidney:	Caprylic acid	8:1	nd	2.0	0.24
	Capric acid	10:0	10.42	5.93	nd
	Lauric acid	12:0	17.37	nd	nd
	Myristic acid	14:0	43.41	7.48	0.51
	Palmitic acid	16:0	1.30	57.06	53.42
	Stearic acid	18:0	18.23	nd	nd
	Oleic acid	18:1	9.26	8.08	8.69
	Linoleic acid	18:2	nd	19.43	35.56
	Arachidonic acid	20:4	nd	nd	1.58
Liver:	Lauric acid	12:0	7.69	1.43	1.50
	Myristic acid	14:0	nd	23.66	1.67
	Stearic acid	18:0	93.31	74.91	91.83

nd: not detected

with that of Eshiett et al., (1979), who reported slight but non-significant increase in carcass weight with increase in energy concentration. Iyayi & Ngodigha (1991) also reported non-significant effect of graded levels of palm oil (0.5, 1.0 or 1.5%) on the weights of liver, heart and kidney of rabbits when fed cassava peel diet. The proportions of liver, kidney and heart to body weight obtained in this study were lower than those reported by Iyayi & Ngodigha (1991) in New Zealand white rabbits. They reported proportions of 0.72, 0.70 and 0.58 for kidney, 0.24, 0.23 and 0.20 for heart and 3.35, 2.94 and 3.11 for liver on diets of 0.5, 1.0 and 1.5% palm oil, respectively. It is also possible that at the level of inclusion, palm oil may not be able to significantly affect carcass or organ weights. Iyeghe and Ekpenyong (1990) in an earlier study, had reported non-significant increase in weight gains in rabbits fed palm oil diets at levels similar to this study. The non-significant effect of palm oil on carcass or organ weights in this study may therefore, substantiate the work of Iyeghe and Ekpenyong (1990) since carcass and organ weights may be reflected in the total body weight gains.

Organ fatty acid composition

Results of percentage of individual organ fatty acid (as percentage of total fatty acid in each organ) are presented in Table 5 and the trend discussed.

Heart: There were seven fatty acids that were detected either in all treatment groups or singularly in each treatment group (Table 5). The trend of the change in fatty acid composition between treatments was not consistent. Percentage of lauric acid in the heart but none was detected in the heart of PO groups. Other fatty acids did not show any consistent pattern. The reasons for the non-detectable levels of caprylic acid in the hearts of rabbits in this study is not known but could be due to the inhibition of the synthesis of caprylic acid by palm oil. The increased level of stearic acid in this study does not agree with the work of Bulhak-Jachymczyk et. al., (1976), who reported decreased level of stearic acid with rapeseed oil. Differences in the source of oil and animal species may have caused the differential results.

Kidney: Kidney fatty acid composition is shown in Table 5. There was increased level of palmitic

PALM OIL SUPPLEMENTATION FOR GROWING RABBITS

acid but decreased levels of oleic and myristic acids with PO diets. Lauric acid was detected in the kidney of the control group but not in the rabbits fed PO diets. On the other hand, caprylic and linoleic acids were detected in rabbits fed PO diets but not in the control group. Other fatty acids in the kidney did not show any particular or consistent pattern of occurrence (Table 5). The detection of arachidonic acid only in the kidney of the 5% PO group may indicate that more arachidonic acid could probably be detected in the kidney with further increase of palm oil in the diet.

Liver: There were detectable levels of only Lauric, myristic and stearic acids in the liver of rabbits as shown in Table 5. Lauric and stearic acids levels decreased with PO supplementation. There were detectable levels of myristic acid in the liver of rabbits fed PO diets but none in the control group. The predominant liver fatty acid in all treatment groups was stearic acid. This result agrees with the observation of Kramer *et al.*, (1975), who reported that the predominant saturated fatty acid in the liver was stearic acid.

There appears to be a consistent decrease in the level of myristic acid in the three organs with PO supplementation, indicating that there was a decrease in its synthesis in the body. More fatty acids were found in the kidney than the heart or liver. Similar observation have been reported by Rashid *et al.* (1973) when Swiss albino rats were fed butter fat diet. Depression or feedback inhibition of hepatic synthesis of fatty acids may have caused the relatively fewer number of fatty acids found in the liver (Bortz, 1967; Sabine *et al.*, 1969; Haghighi-Rad and Polin, 1983). Although, only oils with high levels of linoleic acid are reported to exhibit negative feedback mechanism (Sabine *et al.*, 1969), palm oil which is low in linoleic acid, (about 9.9 - 11.2%) seems to exhibit similar effect in this study with rabbits.

Mortality

Three rabbits fed on the control diet died between the first and second week of the experiment. Post mortem examination showed that death was as a result of septicaemia. It is possible that rabbits on control diet did not have adequate immunity when predisposed to

septicaemic conditions as against those fed PO diets. Development of immune response by increasing antibody formation as a result of fat inclusion in diets have been reported in rabbits (Jezkova and Petz, 1976). Palm oil also contain some quantities of unsaturated fatty acids, which are known to have bactericidal effect or a stabilizing effect on bacterial population in the gastrointestinal tract of rabbits (Fuller and Moore, 1971). The death of one rabbit on the 5% PO diet due to paralysis resulting in urinary incontinence was not related to the diet.

CONCLUSION

The results of this study showed that there was a non significant ($P > 0.05$) increase in carcass or organ weights with palm oil supplementation. Although the levels of organ fatty acid were not tested, palm oil supplementation seems to affect fatty acid composition but there was no consistent pattern for most of the fatty acids except for myristic acid level, which was depressed in the three organs of rabbits fed PO diets. The non significant effect of palm oil in this study may be due to the fact that all diets were made to be sionitrogenous and isocaloric (Table 1), thereby cancelling the effect of the high caloric value of PO in the diet (Table 2). The observed mortality due to septicaemia in the control group and the known fact that PO enhances the development of immunity and its bacteriacidal effect calls for further study in this regard. The cause of paralysis and urinary incontinence in one of the rabbits fed 5% diet was due to spinal injury and cannot be attributed to the diet fed.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the contributions of the following: Mr. W. T. Okoye and staff of the Nigerian Stored Products Research Institute (NSPRI), Ibadan; Prof. A. U. Osagie (Biochemistry Dept., University of Benin) and management and staff of the Biochemistry Division, Nigerian Institute for Oil Palm Research (NIFOR), Benin for their assistance during the course of this work.

REFERENCES

- AOAC (1980). Association of Official Analytical Chemists. Official methods of analysis of the

- association of analytical chemists, 13th ed., Washington, D.C.
- REYNEN, C.A. (1988). Dietary fat level and growth performance by rabbits. *J. App. Rabbit Res.* 11: 21 - 24.
- BORTZ, M.W. (1967). Fat and cholesterol synthesis. *Biochem. Biophys. Acta.* 137: 533.
- BULHAK-JACHYMCZYK, B., KUCHARCZYK, B. and OLSZEWSKZ-KACZNSKA, I. (1976). Effect of dietary erucic acid on the fatty acid composition of the heart and liver phospholipids in rats. *Nutr. Abstr. Rev.* 46: 845.
- ESHETT, N., OMOLE, T.A. and ADEGBOLA, A.A. (1979). Crude protein and energy requirements of rabbits in the tropics. *Nig. J. Agric. Sci.* 1: 113 - 117.
- FULLER, R. and MOORE, J.H. (1971). The effect on rabbit intestinal microflora of diets which influence serum cholesterol levels. *Lab. Anim.* 5: 25 - 30.
- HAGHIGHI-RAD, F. and POLIN, D. (1983). Lipid: the unidentified factor for alleviating fatty liver syndrome. *Nutr. Abstr. Rev.* 53: 172.
- IYAYI, E.A. and NGODIGHA, E. (1991). Performance and organ weights of rabbits fed diets with graded levels of cassava peel and palm oil. *J. Appl. Rabbit Res.* 14: 152 - 154.
- IYEGHE, G.T. and EKPEYONG, T.E. (1990). Effect of palm oil supplementation on growth performance and nutrient digestibility by grower rabbits. *Trop. Anim. Prod. Invest.* 1: 46 - 52.
- JAMES, A.T. (1960). Qualitative and quantitative determination of the fatty acids by Gas Liquid Chromatography. *Methods of Biochemical Analysis.* Inter Science Publishers Inc., New York, Vol. 8: 7 - 19.
- JENXKOVAN, Z. and PETZ, R. (1976). Effect of experimental stress on immunological reactions in experimental atherosclerosis of rabbits. *Nutr. Abstr. Rev.* 46: 235.
- KRAMER, J.K.G., FRIEND, D.W. and HULAN, H.W. (1975). Lipid changes in tissues of young boards fed rapeseed oil or corn oil. *Nutr. Metab.* 19: 279 - 290.
- PUTHZHATH, D. and ALAMELA, V. (1977). Effect of dietary fat on oxidative phosphorylation and fatty acid profile of rat liver mitochondria. *J. Nutr.* 107: 1621 - 1631.
- RASHID, J., SIAL, M.A. and SIAL, M.B. (1973). Influence of various dietary fats on tissue lipid picture of rats. *Nutr. Abstr. Rev.* 4: 297.
- SELL, L.J. and OWINGS, J.W. (1981). Supplemental fat and metabolizable energy-to-nutrient ratios for growing turkeys. *J. Poult. Sci.* 60: 2293 - 2309.
- STEEL, R.D. and TORRIE, J.H. (1960). Principles and procedures of statistics. 1st ed. McGraw Hill Book Co. Inc. New York.
- VODOVAR, N., DESNOYERS, F., CLUZAN, R., MORSON, A.M. and LEVILLIAN, R. (1973). Accumulation of lipids in the myocardium of rats given rapeseed oil in their diet. *Nutr. Abstr. Rev.* 43: 224.
- WILLIAM, M.A., CHU, L.C., MCINTOSH, D.J. and HINCENBERGS, I. (1968). Effects of dietary fat level on pantothenate depletion and liver fatty acid imbalance. *J. Nutr.* 94: 377 - 382.

*Current Address: Department of Animal Production, Ogun State University, P.M.B. 2002, Ago-Iwoye, Ogun State.