

*Full Length Research Paper*

## **Determinants of aggregate household demand for edible oils in Imo State**

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**Edible oils substitutes seem to face a stiff competition in Imo State. This is because they are put to the same use in human diet. Groundnut oil seem to be the worse hit as demand for it is going down in the state, hence, the need to estimate its response to changes in its own price, and that of its substitute as well as consumers' income. The data for the study were obtained from a stratified random sample of 92 consumers of the two products across the three agricultural zones in the state, using a well structured questionnaire. Analysis was done using both economic models and econometric tools like demand elasticities and choice dichotomous (logit) model. The study revealed that palm Kernel oil is price elastic but may not be a close substitute to groundnut oil as a priori expected since its gross price elasticity is less than unity and negative. Surprisingly, increase in consumer's income will lead to less than proportionate increase in demand for palm kernel oil but gives a more than proportionate increase in the demand for groundnut oil in the area. This makes Palm kernel oil an inferior product when compared with groundnut oil though the high cost of production has reduced the relative competitiveness of the two edible oils of plant origin in the state. At 10% significant level, there is the likelihood that palm kernel oil will be preferred to groundnut oil when its own price increases. The likelihood may decrease with increase in consumers' income. Similarly, at 5% significant level, its preference may decrease with an increase in consumers' age and formal educational attainment. The reasons may be high level of education and also may be due to the fact that age exposes the low quality of Palm Kernel oil and high risk of cardiovascular problems associated with it than with groundnut oil. The study suggests that palm kernel oil revenue can be increased if the product is sold at a reduced market price while higher prices will favour the revenue generated from groundnut oil. Palm Kernel oil should be refined further to improve its taste, colour and texture to enable it stand the competition posed by refined groundnut oil in the area.**

**Key words:** Palm kernel oil, groundnut oil, consumers' preference and demand elasticity.

### **INTRODUCTION**

Edible oil is an essential food item in an African diet. Apart from its energy supply and insulatory properties to the body, it is a raw material in the production of fats, soap, beverages. Shivpur (1982) observed that 46 - 57% of oil extract of palm kernel and groundnut oil for instance is for edibility while the fiber is used for livestock feed.

Edible oil is derived from both plant and animal origin. The quantity of edible oil from animal source is insignificant and its content has some poly saturated fat that can lead to complicated health problem such as cardiovascular diseases, if consumed in large quantities (Michael, 1990). Edible oils of plant origin are pure and natural and they include the red palm oils, palm kernel oils, soya bean oil and groundnut oil etc. Most of these oils are extracted from the plant seeds but the red palm oil is extracted from the spongy mesocarp of oil palm

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fruits. It is regarded as the most inferior due to its high content of saturated fat and fatty acid content (Michael, 1990).

The demand for commodity such as edible oils (with close substitutes) is dependent on the preference for the commodity, the substitutes and the price of the product (Olayemi, 2003). Edible oils are themselves close substitutes because the individual components can play the same role in the diet. Though they have the same roles, their taste are different from each other and unit market prices varies with little margin. Increasing the price of one may lead to increase in the demand of the other substitutes, hence, the need to control individual prices of edible oils as a check to the demand of other products by producers in the state. Demand for a commodity is affected by some demand shifters such as taste, consumers' income, population growth (Koutsoyiannis, 1979). The number of uses a product may have can influence its demand and this is what accounted for high demand of red palm oil and palm kernel oils in Nigeria in early 1960's (Anyanwu et al., 1997).

Though there is a wide belief that Soya bean and groundnut oil are superior edible oils to other substitutes at least at domestic level, it should attract a greater preference but the price elasticity of demand for palm oil and palm kernel continues to increase even in recent times (Shivpur, 1982). This study aims to estimate the price, income and cross-price elasticities of demand of the individual components of edible oil as well as the determinants for consumers' preference for the products. The study is relevant to policy makers in suggesting the parameters of increasing supply and ensuring price stability of the three edible oil products in the same market in Imo State.

**MATERIALS AND METHOD**

Imo State is one of the south eastern states in Nigeria, located in the rainforest zone, between latitude 40 45' and 70 15 North of Equator and Longitude 6.50' and 7025' East of Greenwich. The state occupies a land area of 5,100 sq Kilometers lying between the lower River Niger and upper and middle Imo River from where it drew its name. Imo State is bounded on the east, west north and south by Abia, Anambara, Enugu and River State respectively (Ogbonna, 2000). The area has a humid climate (Ijioma and Arunsi, 1990) with a rainfall range of between 1990 to 2200 mm and mean temperature of above 200. Imo State is divided into three administrative areas called senatorial zones, which include Owerri, Okigwe and Orlu zones (Ogbonna, 2000). The study adopted a multi stage sampling. First, two local Government areas were randomly selected from each of the agricultural zones, followed by a random selection of 20 households that demand for any or all the edible oils from each of the LGAs were interviewed using a well structured questionnaire. About 120 households were interviewed but only 92 responses were found useful for the study. The responses were further stratified into 50 and 42 respondent who were in favour of palm kernel and groundnut oil demand respectively.

The study is analyzed with economic and econometric tools. The price, income and cross-price elasticities were estimated using the

ratio of percentage changes in quantity demanded of each of the product and the percentage change in price, income and price of a close substitute respectively (Koutsoyiannis, 1979). This is shown in equation 1 to 3 as

$$\ell_p = \frac{\% \Delta Q_{dd}}{\% \Delta P_i} = \frac{\{100(Q_{i1} - Q_{i2})\}}{Q_{i1}} \div \frac{\{100(P_{i1} - P_{i2})\}}{P_{i1}} \quad (1)$$

$$\ell_i = \frac{\% \Delta Q_{dd}}{\% \Delta I_i} = \frac{\{100(Q_{i1} - Q_{i2})\}}{Q_{i1}} \div \frac{\{100(I_{i1} - I_{i2})\}}{I_{i1}} \quad (2)$$

$$\ell_c = \frac{\% \Delta Q_{dd}}{\% \Delta P_{S_i}} = \frac{\{100(Q_{i1} - Q_{i2})\}}{Q_{i1}} \div \frac{\{100(P_{S1} - P_{S2})\}}{P_{S1}} \quad (3)$$

Equations 1, 2 and 3 can be modify to a corresponding own price, income and cross price elasticities as each of them represents a ratio of marginal changes in quantity demanded to mean changes in price, income and price of the substitute respectively. Hence, the use of Power functional model, whose parameter estimates simply represents the corresponding elasticities, becomes very relevant in this regard (Olayide and Heady, 1982 and adopted by Ohajianya, 2005). The Power functional Form which represents the demand equation for edible oil in this survey is expressed as

$$Q_{dd} = \alpha_0 P^{\alpha_1} I^{\alpha_2} P^{\alpha_3} \quad (4)$$

Where  $\alpha_0$ ,  $\alpha_1$ ,  $\alpha_2$  and  $\alpha_3$  are simple elasticities obtained from the common ratios of change in quantity demanded with respect to change in prices, income or prices of a close substitute and mean prices, income and prices of a close substitute with respect to quantity demanded. Equation 4 can be linearized by applying the natural logarithm of both sides to form a simple linear model for easy estimation.

The own prices, consumers income and price of the substitutes data are fitted into two linearized power models (each representing an alternative edible oils demand equation) before they are subjected to Ordinary Least Square Multiple Regression Analysis, to obtain the corresponding elasticity of demand. Two Cob-Dougllass models for two major edible oils specified in this study are specified as follows.

$$LnQ_{ddK} = Ln\alpha_0 + \alpha_1 LnP_1 + \alpha_2 LnI + \alpha_3 LnP_s \quad (5)$$

$$LnQ_{ddG} = Ln\beta_0 + \beta_1 LnP_1 + \beta_2 LnI + \beta_3 LnP_s \quad (6)$$

Where  $\ell_p$ ,  $\ell_i$ ,  $\ell_c$  = price, income and cross-price elasticities of demand respectively,  $\% \Delta$  = Percentage change,  $Q_{idd}$  = Quantity demanded,  $Q_{ddk}$  = Quantity palm kernel oil demanded,  $Q_{ddg}$  = Quantity groundnut oil demanded,  $P_i$  = price of  $i$ th component of edible oil,  $I$  = consumers incomes,  $P_s$  = Price of the substitute of an  $i$ th component of edible oil.

The factors that accounts for preference for either palm kernel oil or groundnut oil for domestic use in the area is isolated using a dichotomous choice protocols in which the probability of choice between the two substitutable edible oils is a function of price and some socio-economic factors of the consumers (Loureiro and Umberger, 2003; Ehirim et al., 2007). The probability of a "yes response" to groundnut oil rather than its substitute such as palm kernel oil by the consumers is denoted as '1', and otherwise '0'. This shown as:

$$P_{(G)} = \frac{1}{1 + \exp^{-X_i\lambda}} \quad (7)$$

The probability of no response to groundnut oil or palm oil as an alternative edible oil by the consumers is therefore expressed as:

$$1 - P_{(G)} = \frac{1}{1 + \exp^{X_i\lambda}} \quad (8)$$

The ratio of a yes response to its odd response with the natural log of both sides is shown as a linear relationship with the prices of the products and the socio-economic features of the consumers. This is expressed as:

$$\frac{P_{(G)}}{1 - P_{(G)}} = \frac{1}{1 + \exp^{-X_i\lambda}} \div \frac{1}{1 + \exp^{X_i\lambda}} \quad (9)$$

Taking the log of both sides of equation 9, the expression is thus represented as

$$\text{Ln} \left\{ \frac{P_{(G)}}{1 - P_{(G)}} \right\} = X_i\beta + \varepsilon \quad (10)$$

Where = P (G) is a probability of a choice of groundnut oil, exp = exponential sign,  $X_i$  = independent variables, which include the prices of alternative edible oils and the socio economic variables of the consumers,  $\beta$  = conformable vector parameters,  $\varepsilon$  = unobservable (random) variables.

## RESULT AND DISCUSSION

### Estimating the price, cross-price and income elasticities of edible oils in Imo State

Table 1 shows the estimated price, income and cross-price elasticities estimates of the two edible oils from Cobb-Douglass model. The two models each has an estimated F-statistics of 9.19 and 7.10 for the Palm Kernel and Groundnut oil demand equations respectively. These values are greater than the F-tabulated value of 4.02 at 1% critical level. This implies that the two models are better fitted and that the included variable such as own price of the product, price of the substitute of each product and consumer's monthly income each has strong explanation to the variation in demand for either of the edible oils under study in the state. Also their co-efficient of multiple determinations of 0.450 and 0.387 for palm kernel and groundnut oil respectively obtained in the study reveal that all the included variables such as own price, households head monthly income and prices of the substitutes have about 45.0 and 38.7 explanations to the changes in palm kernel and groundnut oil market demands respectively.

It could be deduced from the table that own price elasticity of demand for palm kernel and groundnut oil are 1.28 and 0.68, respectively. This means that as palm

kernel oil is highly elastic as its value of own price elasticity is greater than unity ( $\ell_p > 1$ ) while groundnut oil market demand is inelastic with its estimated own price elasticity of ( $\ell_p < 1$ ) less than unity. It could further be deduced from the result that an increase in price of the palm kernel oil by 1% will result in more than proportionate decrease in demand of 1.28% and 1% fall in demand of groundnut oils will lead to increase in the demand for the product by 0.68%. The economic implication of this to the economy is that increase in price of edible oils will definitely favour the revenue generated from groundnut oils than palm kernel oils in the state (Ojo, 1982; Anyanwuocha, 2001).

The cross price elasticity ( $\ell_c$ ) is less than unity (1) but positive and greater than zero. The result indicated that both edible oils are actually substitutes (Ojo, 1982; Anyanwuocha, 2001). Palm kernel oil is more cross price elastic than groundnut oil. The cross price elasticity of demand for palm kernel oil is close to 1 ( $\ell_c = 0.982$ ) but that of groundnut oil is close to zero ( $\ell_c = 0.008$ ) but positive. The higher degree of responsiveness of demand for palm kernel oil with slight change in price of groundnut oil shows that increase in price for edible oils may favour increase in demand for palm kernel oil than groundnut oil. Palm kernel oil behaves as a shock absorber to edible oil market demands as consumers can always rely on it during crisis.

In the same way, consumers' income which is an important shifter of market demand demonstrated a clear and consistent result. For palm kernel oil, the income elasticity ( $\ell_I$ ) is negative and less than 1. Increase in income of the consumers will lead to a less than proportionate increase in demand for palm kernel oil but a more than proportionate increase in the demand for groundnut oil in the market. Ojo (1982) and Anyanwuocha (2001) individually noted that such negative income elasticity behaviour suggest that the product is an inferior commodity to its substitutes. The income elasticity of demand estimate of -0.764 actually suggested that palm kernel is an inferior product compared to groundnut oil in the market. Consumers with increased disposable income will definitely increase the demand for groundnut oil, thus groundnut oil demand will increase despite its high cost of production if consumers disposable income increases.

### Determinants of consumer's preference for palm kernel oil in Imo State

The dichotomous protocols for a preference for palm kernel oil rather than its substitute in the area was performed using logistic estimate and the result is shown in Table 2. The log likelihood of 18.41 and a chi square of 29.5, which is greater than the tabulated value of 14.07, indicated a good fit for the model. This implies that the included variable may likely determine the preference for palm kernel oil rather than groundnut oil in the area.

**Table 1.** Demand elasticities of different edible oils in Imo State.

Variables	Palm kernel oil model			Groundnut oil model		
	Estimates	t-values	Elasticities	Estimates	t-values	Elasticities
Own price (lnP <sub>i</sub> ) (Std.error)	-1.281 (0604)**	2.12	1.28	0.682 (0.726)	0.939	0.68
Price of substitute (lnP <sub>s</sub> ) (Std.error)	0.982 (1.841)	0.006	0.98	0.008 (0.0054)	1.48	0.008
Consumers income (lnI) (Std.error)	-0.764 (0.388)***	2.653	0.76	1.681 (0.849)	1.979*	1.68
R2	0.450			0.387		
Adj R2	0.411			0.353		
F-statistics	9.19***			7.10***		
Sample size	50			42		

Source: Computation by the author, 2008. Critical t-values at 1, 5 and 10% are 2.61, 1.98 and 1.65, respectively. Significant at 10% (\*), Significant at 5% (\*\*), Significant at 1% (\*\*\*).

**Table 2.** Logistic estimates of consumers' preference for palm kernel oil in Imo State.

Variable	Unit	Estimates	T-values
Price (X <sub>1</sub> ) (Std.error)	Naira	-4.84 (2.49)*	1.94
Price of Substitute (X <sub>2</sub> ) (Std.error)	Naira	0.96 (1.73)	0.56
Age (X <sub>3</sub> ) (std.error)	Years	-0.095 (0.046)**	2.07
Educational attainment (X <sub>4</sub> ) (Std.error)	Years	-0.197 (0.115)*	1.71
Income (X <sub>5</sub> ) (Std.error)	Naira	-1.38 (0.72)*	1.90
Household Size (X <sub>6</sub> ) (Std.error)	Norminal	0.183 (0.102)*	1.79
Sex (X <sub>7</sub> ) (Std.error)	Dummy	0.37 (0.98)	0.71
Constant (Std.error)		-11.34 (2.35)**	4.53
Total observation		92	
Observation with zero (0)		42	
Observation with 1		50	
Loglikelihood estimate		-18.41	
Reshifed loglikelihood		-33.20	
Chi square ( $\chi^2$ ) estimate		29.5***	
Degree of freedom		7	

Source: Computation by the author, 2008. The  $\chi^2$  - values at a critical level of 0.05 and a df of 8 is 14.07. Critical t-values at 1, 5 and 10% are 2.61, 1.98 and 1.65, respectively. Significant at 10% (\*) Significant at 5% (\*\*), Significant at 1% (\*\*\*).

Apart from price of the substitute and sex all other included variables are significant at 10% while age is significant at 5%. However, there is an indication that price of palm kernel oil instead of the price of groundnut oil will inversely influence the preference for Palm Kernel oil. Therefore consumers' of edible oil of plant origin in

Imo State are not ready to compromise with an increase in price of groundnut oil. The consumer age has a strong but negative influence on the likelihood of palm kernel oil demand. Increase in age may lead to reduction in consumption of palm kernel oil in the area. This may be due to cardiovascular diseases associated with palm

kernel oil especially at old age (Michael, 1990).

Michael (1990) noted that consumers at old age tend to shy away from heavy consumption of the product. In the same way consumers' level of formal education attainment and income each has a significant but negative effect on the probability for palm oil demand than its substitute in the area

## Conclusion

The gradual decline in the demand for groundnut oil in Imo State is a source of concern. The price of groundnut oil controls the demand for palm kernel oil in the market. The degree of competition between the two products favors palm kernel oil only when there is a fall in consumer's disposable income and price of groundnut oils. This survey revealed that both palm kernel and groundnut oil can enjoy stiff competition and still perform well in revenue generation in the state despite the drop in consumer's income, if and only if the price of palm kernel oil is reduced but price of groundnut oil increases.

## RECOMMENDATIONS

The findings of this survey give the following recommendations;

1. The revenue generated from palm kernel oils in the state can only be increased if the price of palm kernel oil is reduced below the market clearing price but the price of groundnut oil increased in the area.
2. Palm kernel oil behaves as a shock absorber to edible oil market as low income consumers can always rely on it during crisis periods. Therefore, increasing the production of palm kernel oil is imperative due to its relative importance during crisis periods and when the other edible oils are scarce.

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