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Consumer preferences for cowpea in Cameroon and Ghana

A.S. Langyintuo[a], G. Ntoukam[b], L. Murdock[c], J. Lowenberg-DeBoer[a,*], D.J. Miller[a]

[a] Department of Agricultural Economics, Purdue University, 1145 Krannert Building, West Lafayette, IN 47907-1145, USA
[b] Institute of Agricultural Research for Development, Maroua, Cameroon
[c] Department of Entomology, Purdue University, West Lafayette, IN 47907-1145, USA

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Abstract

Consumer preference information is essential to targeting research. This paper reports an effort of a multi-disciplinary team to measure the market value of cowpea characteristics. Five samples were purchased once per month in seven markets in Ghana and Cameroon starting in September 1996. In the market, price and vendor characteristics were noted. In the laboratory, size of grains, testa color, testa texture, eye color and damage levels were recorded. A hedonic pricing regression model was used. Results indicate that grain size is the most important characteristic. Consumers seem more sensitive to bruchid (Callosobruchus maculates) damage than hypothesized. Cowpeas with white testa command a clear premium only in one of the Ghanaian markets. In Ghana, black eyes sell at a premium, but in Cameroon black eyes are discounted. In general, this study indicates that quality characteristics are very important in West African food markets. Even low income consumers are willing to pay a premium for products that match their preferences, and they are vigilant in identifying products that do not meet their standards. Purchasing samples on a regular basis and hedonic pricing offers a practical way for biological scientists and economists to work together to measure these consumer preferences.

JEL classification: D12; Q11

Keywords: Consumers; Ghana; Cameroon; Hedonic pricing; Cowpea; Bruchids

1. Introduction

Cowpeas (Vigna unguiculata (L.) Walp) are important food legumes throughout West and Central Africa. Although they occupy a smaller proportion of the crop area than cereals, they contribute significantly to household food security in West and Central Africa (Baur, 1992). Because cowpeas mature early, they serve to bridge a hunger gap from late June through August when grain reserves from the previous harvest are depleted and farmers have yet to harvest the current year's crops. As relatively inexpensive sources of high quality protein (Dovlo et al., 1976), cowpeas are important in the nutrition of the poor. Furthermore, as drought tolerant crops that mature on as little as 300 mm of rain, they reduce farmers' exposure to yield risk and serve as important sources of farm income.

The economic and nutritional importance of cowpea in West Africa make it a key subject for research,

* Corresponding author. Tel.: +1-765-494-4230; fax: +1-765-494-9176.
E-mail address: lowenbej@purdue.edu (J. Lowenberg-DeBoer).

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including breeding, agronomy and post-harvest handling. Cost effectiveness requires targeting cowpea research at characteristics that meet consumers' tastes and preferences. Farmers will be reluctant to grow new varieties that consumers will not buy. Producers and merchants will be more likely to adopt storage and post-harvest handling technologies that improve the characteristics that consumers value. Consumer tastes and preferences are reflected in the market through price discounts and premiums that consumers pay for visible grain characteristics. In some cases, these visible indicators are proxies for some biochemical characteristic, such as cooking time, sucrose level or protein content.

In other cases, the visible characteristics are directly related to the way cowpeas are used in food preparation. For instance, cowpea grain or eye color are important considerations when the intended use for the grains requires decortication to remove flecks. Poor milling and winnowing may still leave some flecks for which consumers have a low tolerance. In Cameroon, cowpea 'kosai' (cowpea fritters) without black flecks are very popular while in Ghana black flecks have little impact on the use of cowpeas for 'Tubani' (steamed cowpea paste) or a mixture of cowpea with rice (*Oriza sativa*) or gari (a product from fermented cassava (*Manihot esculenta*) dough). Consequently, Cameroonian consumers may discount grains with colored skin or eyes, especially blackeyes, which tend to produce more conspicuous black flecks than other colors, relative to consumers in Ghana who may be indifferent. In other words, preferences for different culinary roles of cowpea in the two countries can have impacts on the preferences for cowpea grain characteristics.

Therefore, knowledge of consumer's preferences for grain characteristics can help plant breeders and postharvest technologists target attributes which are economically viable in their breeding improvement research and post-harvest technology development, respectively. The results may also be used by the social scientists for public policy research in cowpea marketing, technology assessment and research prioritization.

The objectives of this study are: (1) to evaluate the relative importance of various cowpea characteristics determining cowpea prices in Ghana and Cameroon, and (2) to compare these characteristics across markets in the two countries. To guide the research the following hypotheses were jointly developed and tested in collaboration with cowpea breeders and entomologists: consumers (i) discount black eye cowpeas in both countries; (ii) discount grains with over 100 bruchid (Callosobruchus maculates) holes per 100 grains in both countries; and (iii) are willing to pay a premium for large cowpeas with white testa. These hypotheses were tested using hedonic pricing models. In the next section, we present the framework for a hedonic model as applied to consumer demand for product quality characteristics.

2. The hedonic model framework

The conceptual basis for estimating consumer demand for a good's quality is Lancaster's (1966a,b) model of consumption theory which regards characteristics of the good and not the good itself as the direct object of utility. Thus, price differences across different units of transaction are due mainly to quality differences that can be measured in terms of the characteristics. Using this concept, Ladd and Suvannunt (1976) developed the consumer goods characteristics model which describes the price of a good as a linear summation of the implicit value of its attributes. They showed that;

$$p_i = \sum_{j=1}^{M} \left(\frac{\mathrm{d}X_{0j}}{\mathrm{d}q_i}\right)\left(\frac{\mathrm{d}U/\mathrm{d}X_{0j}}{\mathrm{d}U/\mathrm{d}E}\right), \quad (1)$$

where p_i is the market price of product i, X_{0j} the total amount of the mth product characteristic provided by consumption of all goods, q_i the amount consumed of product i, and E is total expenditure. $\mathrm{d}X_{0j}/\mathrm{d}q_i$ is the marginal yield of the jth product characteristic by the ith product. The marginal utilities of the jth product characteristic and of income are respectively $\mathrm{d}U/\mathrm{d}X_{0j}$ and $\mathrm{d}U/\mathrm{d}E$. If we assume that expenditure equals income, $((\mathrm{d}U/\mathrm{d}X_{0j})/(\mathrm{d}U/\mathrm{d}E))$ can be regarded as the marginal implicit price of the jth characteristic. This may be represented by β_{ij} if we assume a constant marginal implicit price. Given that most product characteristics are constant, the marginal yield $(\mathrm{d}U/\mathrm{d}X_{0j} = X_{ij})$, may be assumed constant.

In terms of the current cowpea demand analysis, Eq. (1) can be expressed as:

$$P_i = \sum_{j=1}^{m} X_{ij}\beta_{ij} + v, \quad (2)$$

where P_i is price of cowpea, X_{ij} the quantity of cowpea grain characteristic j, such as size of grain, testa color, testa texture, eye color and damage by weevils, β_{ij} the implicit price of characteristic j, and v is a stochastic error term. The estimates of implicit values of characteristics can be used to estimate the price of an unobserved product by valuing embodied characteristics (Dulberger, 1989). Hence the implicit prices for characteristics derived from hedonic estimation help highlight areas for future cowpea research and policy initiatives.

Hedonic pricing models have received wide applicability in the scientific world. For example, Bonifacio and Duff (1989) examined the effects of milling and pre-milling operations on rice quality using a hedonic pricing model. Their results indicated insignificant differences in paddy quality by mill type, and confirmed that mill type affects milled rice quality and that millers attach economic significance to certain grain quality characteristics. Abansi et al. (1990) used the hedonic pricing model to evaluate consumer preferences for rice quality in the Philippines. They found that rice consumers attach economic significance to quality considerations. Walburger and Foster (1994) used data on boar performance traits from Purdue University Boar Test Station and auction sales data to estimate the implicit prices for back fat, loineye area, average daily gain and feed efficiency of boars in the US via a hedonic pricing model. They observed that all of these variables significantly impact the auction prices of boars.

3. Estimation of the hedonic model

In this study, data were generated through purchase of samples in seven spatially separated markets, three in Ghana and four in Cameroon, between 1996 and 2000 using similar data collection protocols. The team that developed the data collection protocols included entomologists, plant breeders and economists. The Cameroonian markets are in the Far North Province, which is on the shores of Lake Tchad. Maroua is the provincial capital and largest city in the province. Data were collected at the main retail market, Maroua Central Market. Salak Market is about 20 km south of Maroua. It is a peri-urban market attracting many low income consumers. Banki is on the border to Nigeria. A large portion of the buyers in the Banki market are Nigerian. Mokolo is the largest city in the Mandara mountains and capital of the department of Mayo Tsanaga, which produces more cowpea than any other department in the country. The Mandara mountains are ethnically distinct from the lowlands of the Far North Province. Farmers there preserve many traditional cowpea varieties.

The three Ghanaian markets are in the north: Tamale, Wa and Bolgatanga. Tamale is the capital of the Northern Region. Wa is the capital of the Upper West Region. Bolgatanga is the capital of the Upper East Region. These regions are the main sources of cowpea in Ghana. Of the three towns, Tamale is the largest with two markets, the Central retail market and the Aboabo wholesale-retail market. Data collection took place in the latter market. Bolgatanga has one wholesale-retail market. It is located 160 km north of Tamale but 60 km south of the Burkina Faso town of Guelewongo, where some traders from Tamale and Bolgatanga visit to buy cowpea. The Wa central wholesale-retail market is the main place of commerce in the town. Wa is 400 km west of Tamale and about 160 km south–west of Leo, a town in Burkina Faso from where some traders procure their grains.

Five samples of cowpea were randomly purchased, once per month, in each market. In the market, price and vendor characteristics were noted. In the laboratory, size of grains, testa color, testa texture, eye color and damage levels were recorded. Data collection in Cameroon started in September 1996 in Maroua and Salak markets, and 1 year later in Banki and Mokolo. In Ghana data collection in Tamale started in July 1997, a month earlier than in the other two markets. For the regression analysis, only data from August 1997 to July 2000 were employed. This was the period for which data were available for all markets. The data generated are thus pooled cross-section and time series outcomes with 180 observations per market.

With pooled cross-section and time series data, if the cross-sectional units are distinct units such as households, individuals, etc.; the disturbances of the cross-sectional units may be assumed mutually independent but heteroskedastic while those of the time series autoregressive but not necessarily heteroskedastic (Madalla, 1992; Greene, 1993; Judge et al., 1985; Kmenta, 1997). In this study, the cross-sectional units are randomised individuals and hence the presence of heteroskedasticity is ruled out. However, autocorrelation in the time series component of the model can be a problem. Another important estimation problem is contemporaneous correlation. Cowpea are agricultural commodities, therefore, the effect of weather in a given year and other seasonal effects are likely to have related effects on the disturbances for different demand equations that are not necessarily related to the characteristics of the grains (Judge et al., 1985, 1988; Greene, 1993). When contemporaneous correlation exists, it may be more efficient to estimate all equations jointly with the seemingly unrelated regression estimator (SUR), rather than to estimate each one separately using least squares (Judge et al., 1988; Greene, 1993; Madalla, 1992).

The data were tested for contemporaneous correlation using the Lagrange multiplier statistic suggested by Breusch and Pagan (1979). The estimated chi-squared values for the Ghana and Cameroon models were, respectively, 64.5 and 17.5. The null hypothesis of zero covariance was therefore rejected at the 1% level of significance in favor of the alternative hypothesis that at least one covariance is nonzero for both models. Consequently, the use of SUR[1] for parameter estimation was justified.

For each of the three markets in Ghana and four in Cameroon, the following hedonic equation was specified and estimated using SUR:

$$P_{it} = \alpha + \sum \beta_{ij} X_{ijt} + \sum \psi_{ij} M_{ijt} + \sum \gamma_{ij} Y_{ijt} + \varepsilon_t, \quad (3)$$

where P_{it} is the price of cowpea measured in fcfa[2] kg^{-1} in Cameroon and ¢[3] kg^{-1} in Ghana in market i in time t. The X_{ijt} matrix is made up of bowl weight (weight of grains purchased per the common unit of measure, usually a bowl in grams) and cowpea grain characteristic, j, such as grain size (weight of 100 grains in grams), color of the eye, seed coat color, and number of bruchid holes in every 100 grains. The bowl weight is included as an explanatory variable to account for volume discounts. In the markets cowpea grains are sold by volume and hence prices were observed on per bowl basis which were subsequently converted into per kilograms. Because the volumes are non-standardized, volume discounts are possible since the quantity measured for sale is influenced by supply and the vendor–buyer relationship. Price, bowl weight, grain size and number of holes entered the model as actual values.

The original hypothesis that consumers are insensitive to damage levels of less than 100 holes per hundred grains could not be tested because there were very few samples that exceeded that damage level, probably because damaged grains are sorted out by merchants. In fact, very few samples exceeded 30 bruchid holes per hundred grains. Threshold levels of 30, 20 and 10 holes per hundred grains were tested by creating a variable equal to the number of holes at and above the threshold, and zero below. None of the threshold variables were significantly different from zero. The simple 'number of holes' variable was the most successful.

Grain eye color and seed coat color were entered as dummy variables. For grain color, a value of 1 was assigned to white grain color and zero otherwise. For grain eye color, black-eyed grains assumed a value of 1 and zero otherwise. M_{ijt} and Y_{ijt} are monthly and yearly dummies, respectively, to account for the effect of time in price variability. November was used as the base month since prices in that month were the lowest. For the yearly dummies, 1997 was the base. Each month or year in question assumed a value of 1 and zero otherwise. ε is a stochastic error term and α a

[1] See Judge et al. (1988, pp. 450–468) or any standard econometrics book for an exposition of the seemingly unrelated regression (SUR) analysis procedure.

[2] fcfa = Franc Cooperation Financière en Afrique, the currency used in Cameroon. The exchange rate in August 2000 was US$ 1 = 700 fcfa.

[3] ¢ = Ghanaian Cedi, currency used in Ghana. The exchange rate in August 2000 was US$ 1 = ¢7000.

constant term. β_{ij} is the implicit price of a characteristic j in market i, Ψ_{ij}, and γ_{ij} are parameters corresponding to the monthly and yearly dummy variables, respectively.

4. Results and discussion

4.1. Cowpea grain characteristics in selected markets in Cameroon and Ghana

Across West and Central Africa, there is high variability in cowpea average grain size. Table 1 indicates that in Ghana and Cameroon, the 100 grains weight ranges from 2 to 31 g. For comparison it should be noted that the black-eyed pea sold in dry packs in US grocery stores are usually above 25 g per 100 grains. Grains sold on the Cameroonian markets are, on average, larger than those sold in Ghana. The Ghanaian grains appear to be more uniformly distributed compared to those in Cameroon.

In terms of grain susceptibility to stored pests, cowpeas are relatively vulnerable. Over 50% of the traders interviewed in Ghana used storage chemicals such as Actellic dust to store their grain. In Cameroon over 70% of traders protect their stored grain using various storage technologies either singly or in combination. 68% of them reported using Actellic dust (Pyrimiphos methyl), 23% used Marshall 480 EC (Carbosulfan) and 9% wood ash. 10% of the traders reported using the triple bagging technology developed by the Bean/Cowpea Collaborative Research Support Program (Kitch and Ntoukam, 1992). Despite these storage measures, cowpeas still suffer damage before sale. Therefore, to improve the quality of the lots sold, traders pick out damaged grains before or as they are displayed. The average infestation levels observed as the number of bruchid holes per 100 grains were 13 and 14 holes, respectively, in Ghana and Cameroon (Table 1). In Ghana as in Cameroon, the mean deviations of damaged levels from a 4-year (1997–2000) average are well above the means between March and September (Fig. 1). Minimal or lower levels of infestation between October and February were a result of the availability of new harvests.

Except in Banki in Cameroon and Wa in Ghana, nearly all cowpeas sold are white in color. In Wa, 46% of the grains sold are of traditional small-seeded mixed-colored (mottled of various gradations) varieties, while in Banki a third of the grains are local small-seeded brown cowpeas (Fig. 2). Many Nigerian consumers who shop in Banki are from Maiduguri State which is well known for its brown or red cowpea varieties (e.g. Jan Borno, Jan Tchadi). In terms of grain eye color, over 70% of the cowpeas sold in Ghana were black-eyed. Fig. 3 shows that in Tamale

Table 1
Descriptive statistics of cowpea grains in selected markets in West and Central Africa (1997–2000)

Market	Mean weight of 100 grains[a]		Number of holes per 100 grains		Price per kg[b]	
	Mean (g)	S.D.[c]	Mean	S.D.	Mean (fcfa or ¢)	S.D.
Cameroon						
Banki	16.8 (2.0–31.4)	3.55	11.2 (0–56)	10.27	206.5 (93.1–498.7)	61.59
Maroua	17.5 (11.0–29.2)	3.96	17.6 (0–117)	17.11	230.1 (135.9–444.4)	58.24
Mokolo	13.6 (5.2–22.8)	2.78	11.3 (0–50)	8.78	217.0 (71.4–458.0)	79.69
Salak	15.8 (11.1–25.4)	2.73	17.4 (0–121)	18.52	239.9 (133.9–411.8)	65.81
All markets	16.0 (2.0–31.4)	3.59	14.1 (0–121)	14.61	222.4 (71.4–498.7)	67.84
Ghana						
Tamale	11.6 (10.2–20.0)	2.74	17.6 (0–79)	16.59	877.9 (421.1–1698.1)	295.51
Bolgatanga	12.4 (8.1–18.1)	2.82	14.6 (0–62)	14.70	1015.8 (476.2–2000.0)	306.62
Wa	12.6 (10.1–21.5)	2.60	6.5 (0–30)	5.81	945.8 (481.5–1454.6)	252.85
All markets	12.2 (8.5–20.6)	2.74	13.0 (0–79)	14.00	953.5 (421.1–2000.0)	298.63

[a] In parenthesis are the minimum and maximum values.
[b] Prices in Cameroon are in fcfa (Francs Cooperation Financière en Afrique) while those in Ghana in ¢ (Ghanaian Cedis). Exchange rates as at August 2000 were: US$ 1 = 700 fcfa (in Cameroon) and ¢7000 (in Ghana).
[c] S.D. = standard deviation.

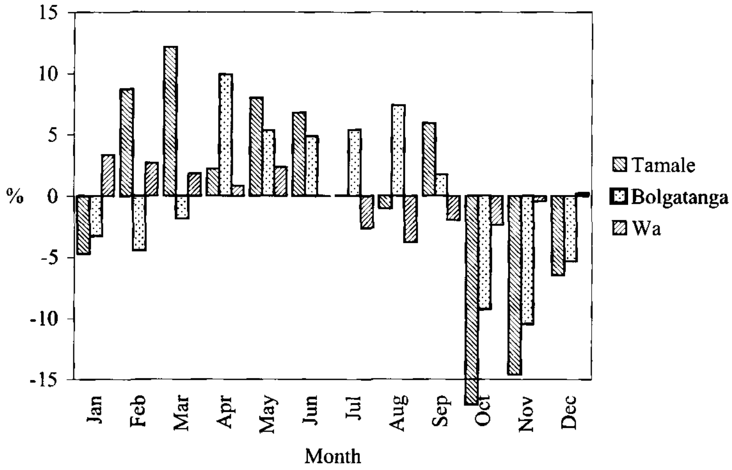

Fig. 1. Mean monthly deviations of grain damage by weevils from the 4-year (1997–2000) average in selected markets in Ghana (%).

and Bolgatanga markets in Ghana, 89 and 98% of cowpeas are black eyed, but in Wa, 69% of the grains sold are mottled and have very few black-eyes. In Cameroon less than 50% of cowpeas are black-eyed. The cowpea grains on the Ghanaian markets were mostly smooth textured except in Wa where about 23% are rough textured. In contrast, most cowpeas sold in northern Cameroonian markets are rough textured except in Mokolo where 11% are smooth, reflecting the importance of traditional varieties in that region.

It should be noted that in West and Central Africa, grain retailing is dominated by females. For example, all cowpea retailers in Ghana are female while in Cameroon they make up 50% with important local differences. In Maroua and Salak, this proportion is as high as 79 and 62%, respectively, compared to only 14 and 44%, respectively, in Banki and Salak. Retailers tend to sell the grains in small quantities, using similar measuring units popularly known as the 'bowl'. Fig. 4 shows that in Cameroon as in Ghana, however, the quantity measured out is adjusted upwards during the harvest season and downwards otherwise. Between November and March soon after the new harvest, traders measure up to 20% over and above the mean measurement quantity. In contrast, during the lean period from May through September,

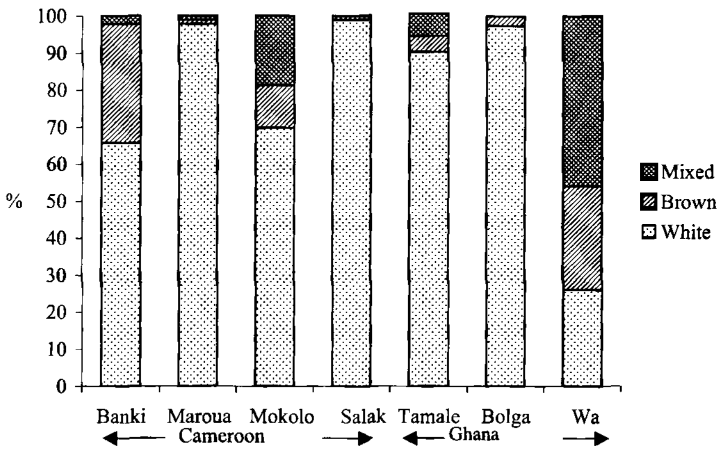

Fig. 2. Distribution of color of cowpea grains in selected markets in Cameroon and Ghana.

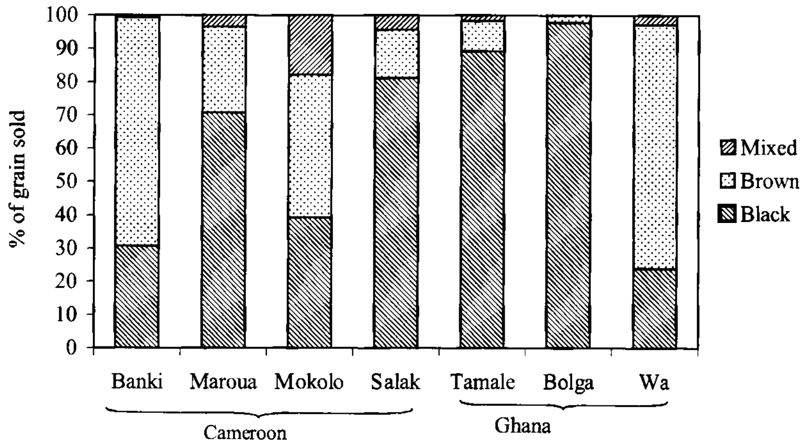

Fig. 3. Distribution of cowpea grain eye color in selected markets in Cameroon and Ghana.

quantity heaped per measurement unit falls short of the 4-year mean by up to 20%. Volume discounts are also possible when selling to a regular customer or acquaintance. As a result of the non-standardized volume measures, the weight of a bowl of cowpea on a given market day on the Cameroonian markets ranges from 1.16 to 3.01 kg at Banki, 0.79 to 1.04 kg at Maroua, 0.9 to 3.5 kg at Mokolo and 0.77 to 1.4 kg at Salak. On the Tamale, Bolgatanga and Wa markets in Ghana, it ranges from 2.25 to 3.2 kg, 2.2 to 3.5 kg and 2.1 to 3.1 kg, respectively.

Cowpea grain prices showed both spatial and temporal variability in both countries. In Cameroon prices range from 71 to 521 fcfa kg^{-1} with mean of 222 fcfa kg^{-1} across all markets (Table 1). The nominal price trends show that the lowest prices are received soon after harvest between August and March (Fig. 5). A similar picture was observed in Ghana. Prices begin to rise steadily to a peak during the following rainy season. Prices observed in Banki are consistently lower than those in Maroua and Salak. In Ghana, prices range from ¢421 to ¢2000 kg^{-1} with a mean of ¢953 kg^{-1} across all markets (Table 1). In Wa, prices are consistently lower than those in Bolgatanga except for the period between September 1998 and July 1999.

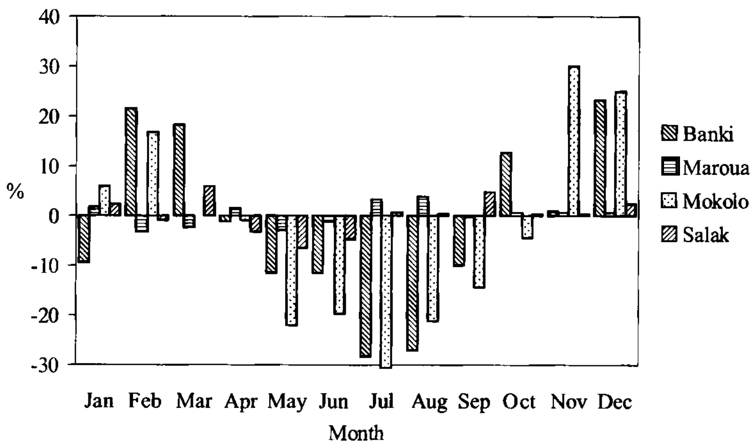

Fig. 4. Percent deviations from a 4-year (1997–2000) mean of the quantity of cowpeas grains sold per measurement unit in selected markets in Cameroon.

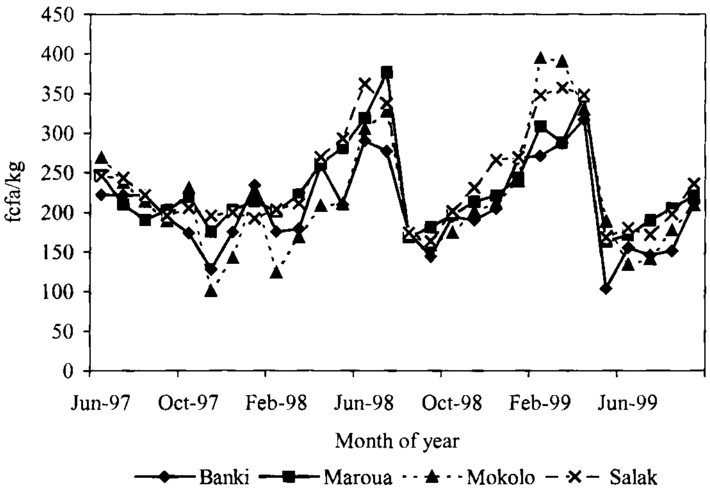

Fig. 5. Nominal cowpea prices in selected markets in Cameroon (fcfa kg^{-1}).

4.2. Hedonic relationship and implicit prices

The estimated regression results indicate that seasonality, grain size, color and insect damage level explain 93 and 97% of price variability in Ghana and Cameroon, respectively (Tables 2 and 3). In all but the Mokolo market in Cameroon, the grain weight per measuring unit is statistically significant in explaining price variability. The price per kilogram decreases as more grains are heaped in the measuring unit for sale

Table 2
Estimated model coefficients for selected markets in Cameroon (1997–00)

Variable	Banki (n = 180)	Maroua (n = 180)	Mokolo (n = 180)	Salak (n = 180)
Bowl weight	−0.01 (0.087)	−0.18 (0.001)	−0.01 (0.172)	−0.17 (0.000)
Grain size	2.46 (0.018)	1.63 (0.037)	2.65 (0.113)	4.08 (0.000)
Number of holes	−0.84 (0.007)	−0.49 (0.003)	−0.24 (0.611)	−0.10 (0.488)
Grain color	9.92 (0.149)	−2.91 (0.887)	13.97 (0.120)	21.94 (0.445)
Color of eye	−3.83 (0.615)	−4.11 (0.497)	10.81 (0.180)	−13.40 (0.021)
January	47.96 (0.006)	26.64 (0.090)	40.53 (0.057)	2.41 (0.867)
February	27.77 (0.090)	26.31 (0.078)	15.10 (0.452)	20.34 (0.139)
March	36.35 (0.035)	47.78 (0.004)	37.91 (0.079)	53.48 (0.000)
April	105.93 (0.000)	65.87 (0.000)	60.65 (0.004)	60.59 (0.000)
May	84.63 (0.000)	102.55 (0.000)	149.28 (0.000)	104.14 (0.000)
June	114.30 (0.000)	112.12 (0.000)	191.05 (0.000)	103.99 (0.000)
July	116.49 (0.000)	112.89 (0.000)	151.84 (0.000)	113.88 (0.000)
August	106.79 (0.000)	125.82 (0.000)	137.53 (0.000)	91.64 (0.000)
September	117.28 (0.000)	121.02 (0.000)	114.06 (0.000)	90.16 (0.000)
October	−3.05 (0.857)	33.73 (0.032)	64.85 (0.003)	5.93 (0.680)
December	19.15 (0.213)	18.06 (0.189)	12.41 (0.502)	−15.40 (0.225)
1998 dummy	34.97 (0.002)	51.66 (0.000)	36.58 (0.007)	32.14 (0.001)
1999 dummy	46.82 (0.000)	45.99 (0.000)	68.44 (0.000)	40.15 (0.000)
2000 dummy	3.48 (0.855)	18.20 (0.285)	49.31 (0.031)	−15.29 (0.344)
Constant	100.20 (0.000)	288.46 (0.000)	75.96 (0.032)	256.79 (0.000)
R^2	0.62	0.64	0.67	0.75
ρ	0.3167	0.6811	0.4307	0.6217

Note: In parenthesis are the P-values; system R^2 = 0.97.

Table 3
Estimated model coefficients for selected markets in Ghana (1997–00)

Variable	Tamale (n = 180)	Bolgatanga (n = 180)	Wa (n = 180)
Bowl weight	−0.42 (0.000)	−0.33 (0.000)	−0.61 (0.000)
Grain size	7.29 (0.098)	15.51 (0.001)	6.02 (0.366)
Number of holes	−2.75 (0.003)	−1.69 (0.062)	−5.07 (0.044)
Grain color	102.00 (0.111)	−47.85 (0.642)	171.06 (0.010)
Color of eye	109.04 (0.051)	430.48 (0.000)	−57.00 (0.394)
January	−195.99 (0.002)	−113.49 (0.088)	8.24 (0.907)
February	−24.33 (0.714)	−90.04 (0.174)	54.18 (0.458)
March	145.39 (0.032)	112.59 (0.098)	92.15 (0.203)
April	204.46 (0.002)	218.38 (0.002)	158.00 (0.032)
May	268.91 (0.000)	216.79 (0.002)	248.58 (0.001)
June	337.93 (0.000)	207.74 (0.003)	193.16 (0.010)
July	510.81 (0.000)	243.30 (0.001)	154.09 (0.049)
August	278.16 (0.000)	230.54 (0.001)	26.65 (0.707)
September	329.05 (0.000)	325.87 (0.000)	105.63 (0.130)
October	225.30 (0.000)	180.04 (0.005)	106.84 (0.115)
December	0.17 (0.0028)	21.57 (0.737)	72.25 (0.284)
1998 dummy	297.24 (0.000)	223.48 (0.000)	128.08 (0.011)
1999 dummy	278.50 (0.000)	289.33 (0.000)	211.53 (0.000)
2000 dummy	615.42 (0.000)	699.12 (0.000)	450.19 (0.000)
Constant	1333.70 (0.000)	970.61 (0.000)	2206.50 (0.000)
R^2	0.62	0.64	0.67
ρ	0.3167	0.6811	0.4307

Note: In parentheses are the P-values; systems R^2 = 0.93.

due to the volume discount. For example, in Maroua market, consumers receive a discount of 0.18 fcfa kg^{-1} on each gram increase in bowl weight. This is equivalent to 0.07% of the average price. In Ghana, this discount is 0.42 cedis kg^{-1} about 0.05% of the average price in Tamale, 0.33 cedis kg^{-1} about 0.03% of the price in Bolgatanga, and 0.61 cedis kg^{-1}, about 0.06% in Wa (Table 3).

Cowpea grain size is statistically significant in five of the seven markets studied. Only at the Wa and Mokolo markets is grain size not statistically significant. At the Maroua, Salak and Banki markets, consumers pay a premium of 2–4 fcfa kg^{-1} g^{-1} increase in hundred grain weight. This premium is 1–2% of the average cowpea price in the Cameroonian markets. In the Ghana markets consumers pay a premium between 7 and ¢16 kg^{-1} per each gram increase for a hundred grains. This is also a premium of between 1 and 2% of the average cowpea price.

All estimated coefficients on the number of holes have the hypothesized negative sign. Except for Mokolo and Salak in Cameroon, all the coefficients are statistically significant at conventional levels. The coefficient for Bolgatanga is, however, significant only at the 10% level. This suggests that consumers in Ghana and Cameroon are more sensitive to bruchid damage than previously hypothesized. In Cameroon, an increase of one hole per every 100 grains leads to a discount of 0.49 fcfa kg^{-1} in Maroua and 0.84 in Banki corresponding to 0.2 and 0.4% of the average cowpea price in Maroua and in Banki, respectively. In Ghana, a discount of ¢2.75 kg^{-1} is estimated for a unit increase in number of holes per 100 grains in Tamale market, ¢1.69 kg^{-1} in Bolgatanga market and ¢5.07 kg^{-1} in Wa market. These discounts represent 0.3, 0.1 and 0.5% of the average cowpea prices in the Tamale, Bolgatanga and Wa, respectively.

Consumers in Ghana and Cameroon seem to differ in their preferences for grain eye color. While consumers in Maroua and Salak discount black-eyed cowpea by 4.11 and 13.4 fcfa kg^{-1}, respectively (Table 2), those in Tamale and Bolgatanga in Ghana pay a premium of between 109 and ¢113 kg^{-1}, or 12 and 11% of the average cowpea grain price in those markets. The cowpea grain color coefficient has the expected positive sign, but it is statistically significant only in Wa (Ghana) where consumers pay a premium for white color up to 18% of the average retail price. Traders in both Ghana and Cameroon receive a premium for storage. In Ghana the premium for selling in the peak price months of May through September ranges from 26% in Wa to 56% in Tamale. The storage premium is higher in northern Cameroon, ranging from 47% in Salak to 87% in Mokolo.

5. Conclusion

This study used samples from seven markets in Ghana and Cameroon to estimate the value of cowpea characteristics for consumers. In both Ghana and Cameroon most consumers prefer large grain size. The premium is 1–2% of average cowpea price per gram increase in 100 grain weight. The exception was the Mokolo markets in the Mandara Mountains of Cameroon and Wa in Ghana where local preference for small-seeded traditional cowpea varieties is apparently very strong. Although consumers are willing to pay a premium for white grain color, the coefficient is statistically significant only in the Wa market where the proportion of white grains was smaller. Cowpea eye color is significant in explaining price variability in both countries. In Ghana, consumers pay a premium of up to 22% of the average cowpea price for black eyes. In Cameroon black-eyed cowpeas are discounted. The results suggest that consumers in Ghana and Cameroon are more sensitive to bruchid damage than hypothesized. In spite of the lack of variability in the damage level data because vendors sort out damaged grains, five of the seven markets show statistically significant discounts for bruchid holes from the very first hole. For statistically significant damage coefficients, estimated discounts range from 0.1 to 0.5% of the average kilogram price for an increase of one bruchid hole per 100 grains.

These results suggest that efforts to improve upon grain size will be worthwhile in both Ghana and Cameroon. Choice of grain eye color should reflect consumers demand. That is, cowpea breeding programs for the Ghanaian markets should emphasize black eye color but those for the Cameroonian markets should avoid black-eyed grains. Consumer sensitivity to grain damage by storage insects indicates that cowpea storage research and technology transfer will have a substantial payoff in West African markets and should also be emphasized.

In general, this study indicates that quality characteristics are very important in West African food markets. Even low income consumers are willing to pay a premium for products that match their preferences and they are vigilant in identifying products that do not meet their standards. Purchasing samples on a systematic basis and hedonic pricing offers a practical way for biological scientist and economists to work together to measure these consumer preferences.

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