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Consumers' preferences for "bicycle poultry" in Benin: Implications for the design of breeding schemes

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Abstract – Village poultry, also termed "bicycle poultry," is produced in scavenging farming systems and is a chewy meat with a low fat content, and constitutes an important source of meat in many African countries. This study investigates consumers' preferences regarding the physical traits of these birds (notably chickens, ducks and guinea fowl) in the Republic of Benin. For this purpose, we applied the hedonic price method on field data collected from retailers in four urban and five rural markets. We found that meatier drake and meatier guinea fowl with white plumage are preferred by consumers who are willing to pay a premium for these types of birds. The factors which significantly influence the price of chicken are the breed of the bird, the plumage color, the meatiness and the age of the bird. Consumers are willing to pay a price premium for meatier birds of traditional breeds with white plumage color and aged between six and twelve months. Thus, efforts to improve local breeds should stress these preferred traits.

Keywords: *village poultry, consumer preferences, willingness to pay, breeding traits, the Republic of Benin*

JEL Classification : D12, Q13, Q11

1. Introduction

Village poultry constitutes an important source of meat in many developing countries, where it accounts for up to 90% of poultry products (Alabi *et al.*, 2006). In West Africa, village (or traditional) poultry represents more than 80% of the total poultry population and a significant proportion of meat (25-70%) and egg (12-36%) production (Karim, 2010; Singh *et al.*, 2011). In Benin, village poultry is the second most common source of meat after beef, with 17% of the meat supply compared to 1% for modern poultry (DE/MAEP, 2008).

In many West African countries, these birds are usually termed “bicycle poultry” for several reasons. “Bicycle poultry” comes from scavenging farming systems and does not need feed apart from what is freely available in nature (as a bike does not need fuel), it has chewy meat with a low fat content (as a bicycle is slim compared to a motorcycle), and farmers tend to transport traditional poultry to the market by bicycle, usually hung on the handlebars (Zoundi *et al.*, 2005; Sodjinou and Koudandé, 2008). Bicycle poultry plays a significant role in the economy of more than 8 out of 10 households and its production is perceived as an activity that can easily generate income for poor rural households (FAO, 2014). Furthermore, several studies (*e.g.* Mack *et al.*, 2005; Aklilu *et al.*, 2008; Sodjinou, 2011; Singh *et al.*, 2011) show that village poultry is not only a useful tool to help poor rural households to recover from disasters, but also a practical and effective first step in abject rural poverty reduction.

In West Africa, the demand for poultry products is higher than the domestic supply from traditional and modern poultry farming so that these countries are (net) importers of poultry products. The coverage rate of the demand for poultry products by domestic production is about 80% in Benin, and less than 60% in many other West African countries (Chrysostome and Sodjinou, 2005; Tougan *et al.*, 2013a). In Ghana, domestic production only supplies around 10 percent of poultry demand in the country (Donkor *et al.*, 2013). The gap between demand and supply will probably increase further in the future, because poultry demand is expected to continue to grow in the coming years (Billaz and Beauval, 2011). To fill this gap, West African countries import poultry products from various countries. The European Union (EU) is the main supplier of frozen poultry products, with Benin (around 9.8% of total EU poultry meat exports) and Ghana (about 4.8% of total EU poultry meat export) being the leading importers in 2012 (AGRITRADE, 2013).

In general, the meat of village poultry is preferred by consumers in comparison with imported frozen chicken meat (Youssao *et al.*, 2013). In other words, consumers generally have a high preference for village poultry and, unlike the local production of modern poultry breeds, village poultry is not significantly exposed to competition from imports of European poultry (Chrysostome and Sodjinou, 2005; CTA, 2008). Indeed, the price of traditional chicken is not affected by imports of frozen poultry meat contrary to domestic “modern poultry” which frequently faces unfair international competition (Billaz and Beauval, 2011).

Due to the importance of village poultry in meat supply and in income generation for rural households, various programs have been implemented to improve productivity. Indeed, the productivity of village poultry is low while it also suffers from poor breeding levels. Most of the programs that were implemented for this purpose, *e.g.* the introduction of cockerels of modern breeds, have failed mainly because they do not take into account consumers’ preferences regarding the various poultry traits (Sodjinou, 2011; Sodjinou and Henningsen, 2012; Vidogbena *et al.*, 2010). The disregard for

consumers' preferences in these programs is at least partly caused by the lack of information regarding these preferences.

The objective of the present study is to investigate consumers' preferences for physical traits of village poultry (chickens, ducks and guinea-fowl) and how research can use these results to improve the performance of village poultry. It is important to understand traditional taste values and their effect on market demand for village poultry (Sonaiya and Swan, 2004), as the provision of information on consumers' preferences can have several uses in the poultry sector. Firstly, it can help researchers and producers to better orient their work in order to develop and produce products (for example animal breeds) that fulfill market requirements and influence attributes that increase poultry prices. Secondly, producers may be able to alter their production practices, *e.g.* the use of inputs or varieties to influence attributes that increase product prices (Carman, 1997). This may also lead to the development of value chains that may contribute to improved living conditions for rural households. Finally, traders will be able to adopt strategies for transport, handling, storage and transformation in order to improve retail level poultry prices through an emphasis on attributes that are important to end users.

2. Methodology

2.1. Theoretical framework

This study focuses on live village poultry also termed bicycle poultry, notably chickens, ducks and guinea fowl. These birds can vary according to certain specific characteristics on which consumers base their purchasing decisions. For example, chickens may vary according to breed, sex, plumage, taste, *etc.* Thus, an indigenous chicken is not the same as an imported chicken of a modern breed. In the same way (in Benin), a chicken with a white color is not the same as one with a black or red color (Sodjinou, 2011). In short, each bird has a bundle of characteristics or traits.

According to Becker's (1965) and Lancaster's (1966) consumer theories, consumers have preferences for the characteristics of bicycle poultry. In other words, consumers can compare various bundles of poultry traits and decide which bundle gives them the greatest pleasure (Perloff, 2011). They choose the birds through utility maximization with respect to the consumption characteristics of the goods (Laroche Dupraz *et al.*, 2008).

Various studies have relied on Lancaster's theory to investigate consumers' willingness to pay for the attributes of various goods, especially when the quality surcharges are not directly observable on the market (Laroche Dupraz *et al.*, 2008). In practice, one often analyzes the price variation of a good over its characteristics. This approach is called the *hedonic pricing method*. For instance, Jabbar (1998) used this method to reveal attributes of goats and sheep that determine consumers' preferences in Southern Nigeria. Orden *et al.* (2005) also

used hedonic regression to analyze traders' preferences for goat characteristics in the Philippines. The purpose of their study was to determine whether the goats' characteristics are important price determinants of these animals.

The *hedonic price* analysis aims to disentangle various attributes from one another for the purpose of estimating implicit prices (Andersson, 2000). Its subjacent assumption postulates that each good is characterized by a set of traits. In other words, hedonic prices are the implicit prices of various attributes embodied in a commodity. Thus, the price of a good is a function of the amount of the attributes that it contains and of the values placed on these attributes (Carman, 1997).

For a given good, the hedonic regression can be written as follows:

$$p = f(x), \quad (1)$$

where $x = (x_1, \dots, x_k)$ ' is the set (vector) of traits for the good, and p is its price. The implicit or hedonic prices are the partial derivatives of the hedonic function of equation (1):

$$\frac{\partial p}{\partial x_k} = \frac{\partial f(x)}{\partial x_k}, \text{ with } k = 1, \dots, K \quad (2)$$

2.2. Data used

The study was carried out in Benin, a tropical West African country between the 6th and 12th parallels of north latitude and between the 1st and 4th Meridian of longitude. Data used were gathered on nine markets: three rural and two urban markets in the southern part, and two rural and two urban markets in the northern part. These markets were sampled by Sodjinou (2011) in order to assess village poultry producers' access to market. In each market, a list of poultry traders operating in the market was made with the help of key informants. Afterwards, traders were sampled at random: 10 in each rural market and 20 in each urban market. In short, a total of 130 village poultry traders were interviewed during marketing poultry transactions.

In each market, the surveys were conducted during two market days. During the first market day, semi-structured discussions (including one focus group discussion *per* market) were conducted with poultry traders in order to identify various attributes that could influence the village poultry price. These traits included the breed of the bird, its live-weight, sex, color of plumage, size (height on leg), meatiness¹, age, and others (length and color of the beak, the presence of feathers on the neck, *etc.*).

¹The meatiness of the bird is defined by a well-muscled body which indicates a higher dressing and carcass yield (Orden *et al.*, 2005).

During the second market day, personal interviews were conducted at the outlets of the village poultry traders, using structured questionnaires. Data on the characteristics of traders and the types of their marketed poultry products were collected. Traders were also asked to rank their preferred poultry traits when purchasing chickens, ducks or guinea fowl. Further, traits of the bird (chicken, duck, guinea fowl) purchased by the first buyer who came just after the discussion with the trader were recorded; and then enumerators approached every fifth consumer who bought poultry from the interviewed trader within 45 minutes after the interview. Before the interview, consumers were asked whether they would agree to undergo a short interview about the products they had bought.

The administration of the questionnaire was made possible with the help of eight enumerators who had at least a *Baccalaureate* (Benin national secondary-school diploma) with at least five years' experience in socioeconomic data collection. Enumerators were given a one-day training session during which they were introduced to the purpose of the study and its scope. They were then taken through the questionnaire: each question was read and explained, and the idea behind the question stressed. Furthermore, each enumerator was equipped with digital scales for bird weighing.

2.3. Data analysis

There are various functional forms that can be used to estimate the hedonic price, for instance standard linear regression, the semi-logarithmic approach, the double log approach and the logarithmic approach. On a theoretical level, there is no consensus regarding the preferred functional relationship (Dalton, 2004). In this study, we used the semi-logarithmic functional form to estimate the relationship between price and bird attributes. The model is described by:

$$\ln p = \beta_0 + \sum_{k=1}^K \beta_k x_k, \quad (3)$$

where p is the price of the live bird in FCFA² per kilogram of live-weight bird and x_k is the bird's k -th attribute. There is no *a priori* rule about which quality characteristics should be included in the model, but the characteristics included should be observable and economically relevant for the buyers (Orden *et al.*, 2005). The characteristics used in this study were identified from semi-structured discussions with poultry traders in an exploratory phase (see details in section 2.2). These attributes include:

²FCFA: Benin currency. Euro 1 = FCFA 655.

- the breed of the bird. The following three types of breeds were identified among chickens purchased by consumers interviewed in this study: indigenous chickens, modern breeds, and crossbred chickens. Based on these three modalities, we introduced two binary (dummy) variables in the model, notably INDIG (with 1 for an indigenous chicken and 0 otherwise) and CROSSB (with 1 for a crossbred chicken and 0 otherwise). Since consumers generally have a preference for indigenous chickens (see the introductory section), we hypothesize that the variable INDIG will have a positive sign, meaning that consumers will prefer indigenous to other types of chicken. Regarding the variable CROSSB, a number of consumers may prefer it because it is produced under the same conditions as indigenous chickens. In contrast, other consumers may not prefer it, since it has a conformation close to that of modern breeds. Accordingly, we assume that this variable may have a positive or negative influence on the price of chicken. Our analysis for ducks and guinea fowl does not take the breed into account, because only indigenous breeds of duck and guinea fowl were available on the market.
- the color of the plumage. Various studies (*e.g.* Aklilu, 2007; Vidogbena *et al.*, 2010) have highlighted the influence of the plumage color on consumers' choice of the type of poultry. During the exploratory survey, white, black, or white speckled with black were highlighted as affecting consumer preference and in turn the price of the bird. We introduced the following two dummy variables in the hedonic regression: WHITE (1 for white plumage and 0 otherwise) and BLACK (1 for black plumage and 0 otherwise). We hypothesize that the white color will have a positive effect on the price of poultry, unlike the black color which we hypothesize will have a negative effect on consumers' willingness to pay;
- the sex of the bird (SEX), 1 for male poultry and 0 for female. According to Tougan *et al.* (2013b) and Sunday *et al.* (2010), the sex of the bird influences the quality of poultry meat. Indeed, these authors state that males are less fatty (at equivalent age) than females. Put differently, they note that the lipid content of chicken meat seems to be higher in females than males, but crude protein content is higher in males than females. It follows that consumers who are averse to fat will have a preference for cockerels. Therefore, we assume that the sign of the variable SEX will be positive;
- the height (HEIGHT), with 1 for long legs and 0 otherwise. During the exploratory survey, the interviewees indicated that the height of the leg can affect the final sales price of the bird. However, no agreement could be found on the direction of this influence. Indeed, a number of interviewees thought that poultry with long legs are more expensive than poultry with short legs, while others disagreed. Given this lack of consensus, we hypothesize that the effect of this trait on the sale price of poultry may be positive or negative;

- the meatiness (MEATY), with 1 for very meaty poultry and 0 otherwise. The consumer primarily wants the meat when buying a bird. As a result, we expect that consumers prefer meatier birds. It follows that meaty birds will tend to have a higher price than slender birds. In other words, this variable is assumed to have a positive influence on the price of the bird;
- the age of the bird. When buying a bird, consumers also take into account its age (see Aklilu, 2007). Yet, the age of birds from traditional farming is often difficult to determine, unlike the age of poultry from modern farming. However, traders with experience gained over years in the business usually have an idea of the approximate age of the poultry. This is corroborated by the findings of Aklilu (2007) who indicates that, in Ethiopia, experienced buyers and traders estimate the age by looking at the roughness of the legs of the birds, where birds with rough legs are usually considered to be old. In our study, we distinguish three categories of birds' age: (i) less than 6 months old, (ii) 6 to 12 months old, and (iii) more than 12 months old. On this basis, two dummy variables were used in the model for chicken, AGE1 (with 1 for chickens aged less than 6 months and 0 otherwise) and AGE2 (with 1 for chickens aged between 6 and 12 months and 0 otherwise). For ducks and guinea fowl, only variable AGE2 was included in the model, because all sold ducks and guinea fowl in our analysis were at least 6 months old. Following Tougan *et al.* (2013b), the age of the bird can affect the quality of its meat, and the ideal slaughter age of chickens is between 6 and 12 months. Accordingly, we assume that AGE2 will have a positive effect on the price, *i.e.* consumers will be more willing to buy poultry which is 6 to 12 months of age. In contrast, we hypothesize that the effect of the variable AGE1 on the sales price of poultry may be positive or negative.

Overall, the variables described above are dummy variables. In a semi-logarithmic functional form, the effect of a dummy variable on the dependent variable is not equal to the first derivative of the regression function with respect to the dummy variable in question, unlike the effect of a continuous variable (Kennedy, 1981). In other words, $\hat{\beta}_k$ is only a potentially imprecise approximation of the effect of a dummy variable x_k on $\ln p$. Among the approaches available in the literature to correct this, Derrick (1984) and van Garderen and Shah (2002) argue that the method suggested by Kennedy (1981) remains less biased and should be preferred in practical applications. Following this method, the effect of a change of x_k from zero to one on p , can be calculated as follow (Kennedy, 1981):

$$g_k^* = \exp \left(\hat{\beta}_k - \frac{1}{2} \hat{V} \left(\hat{\beta}_k \right) \right) - 1, \quad (4)$$

where $\hat{V}(\hat{\beta}_k)$ is the estimated variance of estimated coefficient $\hat{\beta}_k$.

Finally, when analyzing the traders' ranking of the importance of different poultry attributes, we used Kendall's concordance test to investigate the concordance in the traders' rankings. The Kendall's concordance coefficient (W) varies between 0 and 1, where values close to 0 indicate an important discordance in the ranking, while values close to 1 indicate a high concordance in the ranking (Dagnelie, 1998: 404).

3. Results and discussion

3.1. Description of interviewed traders and birds' attributes

Description of interviewed traders

Descriptive statistics of the interviewed traders are presented in Table 1. Most interviewed traders were women (61%). The same trend was observed in both urban and rural areas. As Sodjinou (2011) noted, marketing activities are much more the domain of women than of men in Benin.

For about 84% of the interviewed traders, poultry trade is their main activity. In urban areas, nearly a third of interviewed traders have inherited their activity from a parent, which is in contrast to rural areas where 62% of interviewees started trading poultry on their own initiative. The average age of traders is 42 years, with about 18 years of experience in the poultry trade.

Table 1. Some characteristics of village poultry traders

Characteristics	Area		
	Rural	Urban	All
Sex of the trader (%)			
Female	61.7	60.0	60.6
Male	38.3	40.0	39.4
Education (% of yes)	29.8	28.8	29.1
Main activity (%)			
Other activity	21.3	12.5	15.7
Poultry trade	78.7	87.5	84.3
How did you start marketing poultry products? (%)			
Inheritance	19.1	65.8	48.4
On own initiative	61.7	29.1	41.3
Advice from friend/parent	19.1	5.1	10.3
Belong to any traders' association (% of yes)	19.1	42.5	33.9
Age of the trader	41.5 (9.6)	41.8 (9.5)	41.7 (9.5)
Number of years of experience in poultry trade (years)	15.7 (9.6)	19.6 (11.3)	18.2 (10.8)

() Figures in parenthesis are standard deviations

About 34% of village poultry traders belong to a traders' association/organization. Higher values are observed among urban traders, with around 43%, than among rural traders with around 19%. In urban markets, notably in Cotonou, these associations mainly concern the sale of poultry products, whilst in rural markets, associations are concerned with all agricultural products, including poultry. In the analyzed urban markets, the aim of traders' associations is to reduce or prevent the entry of new poultry product traders. This is why the majority of poultry traders (66%) in urban markets have inherited their activity. In Dantokpa market (Cotonou), wholesalers clearly stated that only people whose parents (mainly their mothers) had been involved in the poultry trade, or those who had served other poultry traders for many years, are allowed to operate in their market as poultry traders (Sodjinou, 2011). In the other studied markets, these associations are set up mainly for social purposes, *e.g.* to assist members in case of difficulties.

Descriptive statistics on birds' attributes

Descriptive statistics of the attributes of the birds in our sample are presented in Table 2. More than half of the surveyed consumers in rural areas bought indigenous chickens. In urban areas, about half of the consumers bought crossbred chickens.

As stated in section 2.3, only indigenous breeds of duck and guinea fowl were available on the market. This may indicate that consumers' preferences for indigenous guinea fowl and ducks are so high that the demand for modern breeds of these birds is so low that modern breeds of these birds are not offered on the market. Thus, the introduction of modern breeds is probably not relevant for these two birds (unless there are large changes in production costs).

Regarding the plumage color of purchased birds, the majority of consumers interviewed in rural areas (about 50% of them) bought white-feathered chickens, whereas in urban areas, the choice is shared between white and other colors (red, mixed color, *etc.*). Purchased chickens, of which 48% were male, weighed 1.5 kg on average. About 53% of chickens were 6 to 12 months old and 32% were less than 6 months old. Furthermore, 19% of chickens had long legs and 29% were very meaty.

About two thirds of the interviewed consumers in urban areas bought white-feathered guinea fowl unlike the rural areas where only one third of purchased guinea fowl was white-feathered, while black was the most common plumage color. Regarding ducks, consumer choice is shared between black and white, regardless of the area considered. Over a third of ducks were males and 57% were between 6 and 12 months old. Regarding the guinea fowl, 61% were males and 52% were between 6 and 12 months of age.

Finally, the selling price of a kilogram of duck and guinea fowl in urban areas is higher than the price in rural areas. For chicken, the average selling

Table 2. Descriptive statistics of birds' attributes

	Chicken			Duck			Guinea fowl		
	Area			Area			Area		
	Urban	Rural	All	Urban	Rural	All	Urban	Rural	All
Breeds (%)									
Indigenous	28.8	52.3	38.2	100	100	100	100	100	100
Crossbred	47.0	29.5	40.0	0	0	0	0	0	0
Modern	24.2	18.2	21.8	0	0	0	0	0	0
Plumage color (%)									
White	34.8	40.9	37.3	38.5	45.5	40.5	66.7	33.3	57.6
Black	27.3	27.3	27.3	34.6	45.5	37.8	25.0	44.4	30.3
Other	37.9	31.8	35.5	26.9	9.1	21.6	8.3	22.2	12.1
Sex (%)									
Female	50.0	54.5	51.8	53.8	81.8	62.2	45.8	22.2	39.4
Male	50.0	45.5	48.2	46.2	18.2	37.8	54.2	77.8	60.6
Height (%)									
Long	28.8	4.5	19.1	38.5	9.1	29.7	83.3	100.0	87.9
Otherwise	71.2	95.5	80.9	61.5	90.9	70.3	16.7	0.0	12.1
Meatiness (%)									
Highly meaty	21.2	40.9	29.1	53.8	45.5	51.4	58.3	55.6	57.6
Otherwise	78.8	59.1	70.9	46.2	54.5	48.6	41.7	44.4	42.4
Age (%)									
≤ 6 months	24.2	43.2	31.8	0.0	0.0	0.0	0.0	0.0	0.0
6 – 12 months	59.1	43.2	52.7	57.7	54.5	56.8	54.2	44.4	51.5
> 12 months	16.7	13.6	15.5	42.3	45.5	43.2	45.8	55.6	48.5
Price (FCFA/kg)									
Indigenous	1546.7	1397.1	1464.8	1500.5	1386.9	1466.7	1479.8	1374.5	1451.0
	(353.1)	(292.8)	(326.2)	(330.7)	(372.7)	(342.5)	(332.8)	(239.7)	(310.3)
Crossbred	1114.9	1034.8	1091.2	Nd	Nd	Nd	Nd	Nd	Nd
	(305.3)	(219.2)	(282.5)						
Modern	1045.5	1078.3	1056.4	Nd	Nd	Nd	Nd	Nd	Nd
	(156.0)	(211.3)	(172.4)						
All	1222.4	1232.1	1226.3	1500.5	1386.9	1466.7	1479.8	1374.5	1451.0
	(356.6)	(308.7)	(336.8)	(330.7)	(372.7)	(342.5)	(332.8)	(239.7)	(310.3)

() Standard deviations in parentheses; Nd: Not determined

price is almost the same in rural and urban areas, when one does not take the breed into account. However, analysis by breed shows that sale prices of indigenous and crossbred chickens are higher in urban than in rural areas. For chicken of modern breeds, the average selling price in rural areas is almost the same as in urban areas. The selling price of the traditional breed is 39% higher than the price of the modern breed and about 35% higher than the price of the crossbred chicken. This result is in line with the findings of Chrysostome and Sodjinou (2005) who, in an analysis of the price of traditional chicken and modern chicken breeds over the period 1996-2002, found that the price of local chicken was on average 24% higher than the price of modern breeds, whatever the period of year. They also found that the difference between the price of traditional chicken and the price of modern breeds had increased over time. This could indicate that the demand for the traditional chicken has increased more than the supply.

Traders' ranking of poultry attributes

Our analysis of the traders' ranking of poultry attributes is presented in Table 3. Kendall's concordance coefficient (W) and a corresponding Chi-squared test indicate that there is a moderate and statistically significant concordance between the rankings of the different breeders for each of the three poultry species. On average, the traders deem the birds' weight and meatiness to be the most important factor affecting the village poultry price. For chicken, the second most important characteristic is the color of the plumage, while the sex of the bird comes in third position followed by the breed and length of the leg. For guinea-fowl, the length of the leg is the second most important factor, followed by the sex and the breed. For ducks, the sex of the animal is the second most important factor followed by the length of the leg. The plumage color and the breed come in fourth and fifth positions, respectively.

Table 3. Traders' rankings of village poultry characteristics

Characteristics	Chicken	Guinea-fowl	Duck
Breed	4 (4.09)	4 (4.42)	5 (4.66)
Color of the plumage	2 (3.86)	5 (4.71)	4 (4.26)
Length of leg	5 (4.36)	2 (3.98)	3 (4.16)
Weight/Meatiness	1 (2.04)	1 (1.67)	1 (2.07)
Origin	7 (6.11)	7 (6.36)	7 (6.47)
Other criteria	6 (5.75)	6 (5.18)	6 (5.54)
Sex	3 (3.97)	3 (4.37)	2 (3.37)
N	128	112	90
Kendall's W	0.319	0.355	0.362
Chi-Square	286.06***	277.96***	228.34***

(): Numbers in parentheses are mean ranks; *** Significant at 1% with 6 degrees of freedom

3.2. Results of the hedonic price regression

The results of our hedonic price regression are presented in Table 4, while the corresponding effects of the characteristics on the price are presented in Table 5. The *breed of the bird* has a significant ($p < 0.01$) effect on the price of chicken. The chicken price tends to be, *ceteris paribus*, 42% higher for indigenous chickens than for modern breeds, which indicates that consumers were willing to pay, *ceteris paribus*, roughly 517 FCFA/kg more for indigenous chickens than for modern breeds, whereas the price of crossbred chicken is *ceteris paribus* about the same as the price of modern breeds. This result supports those of Djondo (2001) and Kyarisiima *et al.* (2011) who found that 90% of interviewees in Benin and 80% of chicken consumers in Uganda, respectively, preferred local chicken meat to that of the modern poultry breeds. This can be explained by the consumers' perception of indigenous chicken.

Table 4. Estimation of the hedonic price model for poultry

Variable	Label	Chicken	Duck	Guinea fowl
		coefficient	coefficient	coefficient
CROSSB	Crossbred (1 = yes, 0 = otherwise)	0.053 (0.057)	Nd	Nd
INDIG	Indigenous (1 = yes, 0 = otherwise)	0.353*** (0.057)	Nd	Nd
WHITE	Color white plumage (1 = white, 0 = otherwise)	0.085** (0.043)	-0.041 (0.066)	0.163** (0.069)
BLACK	Color black plumage (1 = black, 0 = otherwise)	-0.037 (0.045)	-0.042 (0.062)	-0.048 (0.072)
SEX	Sex of the bird (1 = male, 0 = female)	0.026 (0.044)	0.218*** (0.073)	-0.029 (0.062)
HEIGHT	Length of leg (0 = short, 1 = long)	0.058 (0.059)	0.087 (0.074)	-0.113 (0.096)
MEATY	Meatiness (1 = very meaty, 0 = otherwise)	0.109** (0.048)	0.154** (0.061)	0.122* (0.071)
AGE2	Age of the bird (1 = between 6 and 12 months, 0 = otherwise)	0.107* (0.060)	-0.023 (0.064)	0.020 (0.068)
AGE1	Age of the bird (1 = less than 6 months, 0 = otherwise)	-0.027 (0.063)	Nd	Nd
(Constant)		6.796*** (0.074)	7.124*** (0.065)	7.216*** (0.118)
F		8.579***	4.983***	3.470**
R Squared		0.436	0.499	0.445
Adjusted R Squared		0.385	0.399	0.317
N		110	37	33

() Standard errors in parentheses; Nd: Not determined; *** Significant at 1%, ** Significant at 5%, * Significant at 10%

Indeed, during the focus group discussions carried out at the analyzed market places, people stated that consumers from urban areas prefer indigenous breeds not only for their organoleptic qualities (tastier and with a nicer smell), but also for their dietetic qualities. In the latter case, the consumers think that the meat of local chicken contains less fat than the meat of modern chicken breeds, and thus they consider the meat of indigenous chicken to be healthier than the meat of modern breeds. In other words, the perceived link between the consumption of indigenous poultry and health is an important determinant of consumers' – notably the urban wealthy consumers – preference for bicycle poultry. In addition, people think that the local chickens are natural, nourishing, tasty, and contain no chemical products (Djondo, 2001; Laroche Dupraz *et al.*, 2008). Thus, consumers are willing to pay a higher price premium for indigenous birds' meat because: (i) the village poultry's meat is considered to be tastier than commercial hybrid birds (derived from imported stock); and (ii) the birds are not fed with compounded feed, which may contain antibiotics, anti-mould compounds, enzymes and other medicines or synthetic chemicals (Sonaiya and Swan, 2004).

In most West African countries, consumers prefer the tough meat that characterizes indigenous poultry, because most meat is used in soups, while the meat from modern breeds is too tender to hold up under long cooking times (Schneider *et al.*, 2010). This certainly also explains consumers' strong preference for bicycle poultry. Indeed, bicycle poultry meat (muscle tissue) is tougher, and retains its texture when cooked in dishes requiring longer cooking times (Sonaiya and Swan, 2004). Furthermore, to be sure of the type of poultry meat they consume, wealthy consumers prefer to buy live indigenous poultry because of a lack of trust regarding the slaughtering method, fear of disease or sick birds slaughtered (Islam, 2003). However, this result is contrary to the findings of Laroche Dupraz *et al.* (2008) who argued that wealthy consumers in Cameroon prefer imported frozen chickens mainly because of difficulties related to the processing of local live broilers. The creation of slaughter houses improvised by women in some urban markets (as Dantokpa in Cotonou and Ouando in Porto-Novo) allows consumers to overcome this difficulty in Benin (Chrysostome and Sodjinou, 2005; Sodjinou, 2011).

Finally, the consumers' preference for indigenous poultry is also due to their belief that bicycle poultry plays a vital role in socio-cultural functions, for which modern chicken breeds are not acceptable (Emuron *et al.*, 2010). Indeed, the use of indigenous poultry for rituals is common in many countries in Africa and Asia. For example, Masuno (2008) found that poultry consumption for rituals accounts for 88.9% of total chicken consumption in Northern Thailand. With regards to the use of poultry for ritual purposes, the color of the plumage plays a significant role. This is corroborated by the significant effect of the plumage color on the price of poultry that is obtained in this study.

Table 5. Relative and absolute change in price when poultry's attributes change by a unit

Characteristics	Chicken			Duck			Guinea fowl		
	B ⁽¹⁾	Relative change ⁽²⁾	Absolute change ⁽³⁾	B ⁽¹⁾	Relative change ⁽²⁾	Absolute change ⁽³⁾	B ⁽¹⁾	Relative change ⁽²⁾	Absolute change ⁽³⁾
CROSSB	0.053	0.053	64.9						
INDIG	0.353	0.421	516.5						
WHITE	0.085	0.088	108.1	-0.041	-0.043	-62.4	0.163	0.175	253.6
BLACK	-0.037	-0.037	-45.5	-0.042	-0.043	-62.7	-0.048	-0.049	-71.1
SEX	0.026	0.026	31.5	0.218	0.241	352.8	-0.029	-0.030	-44.2
HEIGHT	0.058	0.058	71.0	0.087	0.088	129.2	-0.113	-0.111	-161.5
MEATY	0.109	0.113	139.0	0.154	0.165	241.3	0.122	0.127	184.6
AGE1 (< 6 months)	-0.027	-0.028	-34.5						
AGE2 (6-12 months)	0.107	0.110	135.4	-0.023	-0.025	-36.6	0.020	0.018	26.5

(1) Partial derivative from Table 4

(2) Relative change of the price if x is increased by 1 unit

(3) Absolute change of the price (in FCFA/kg) if x is increased by 1 unit, calculated at the mean price.

Indeed, the *white plumage* has a significant and positive influence ($p < 0.05$) on the chicken price. *Ceteris paribus*, the price tends to be 9% (108 FCFA/kg) higher for a white chicken than for chicken of other colors. White plumage also positively influences the price of guinea fowl ($p < 0.01$), and *ceteris paribus* the price for guinea fowl with white plumage tends to be around 18% (254 FCFA/kg) higher than for guinea fowl with other plumage colors. In contrast, white plumage has no significant effect ($p > 0.10$) on the price of duck. Similarly, prices of poultry with black plumage and of poultry with other (non-white) plumage are not significantly different ($p > 0.10$) for any of the three types of poultry.

The positive effect of the white color on the chicken price is likely related to the religious use of these birds. In fact, chickens are sacrificed during various traditional ceremonies. Chickens that have white plumage are offered in sacrifice to the voodoo god named *Doudoua*. The use of this color in traditional ceremonies is due to the perception that the white feathers are a symbol of peace in Benin (Vidogbena *et al.*, 2010). Guinea-fowl with white plumage speckled with black are especially used in sacrifices to the voodoo god "*Doukounou*" (owner of wealth) in order to ask for good wealth. Ducks with white plumage or ash are preferred for the dowry of women. Chickens with red plumage are destined for the god "*Hebiosso*" (god of thunder, owner of rain). Sonaiya and Swan (2004) found a similar result in northern Ghana (West Africa) where, in Mamprusi society, a red cockerel is sacrificed to ask for rain or a good harvest.

Chickens termed "*Kpinkoun*" (white speckled with black plumage) are sacrificed to the voodoo gods "*Dan*" and "*Sakpata*." Chickens with black, white or red plumage are used to ward off misfortune and to ask for good luck. Sacrifices performed to invoke the spirit of death require chickens with black plumage. However, a black color does not have a significant effect on the chicken price, since this color is widely available. In addition, consumers often have a poor perception of the color black: black chickens are believed to bring misfortune (Aklilu, 2007), and are often used in magic (Vidogbena *et al.*, 2010). Following these authors, farmers believe that they lose utility when keeping black chickens instead of white chickens. Guinea-fowl with black plumage are used for ceremonies and sacrifices to deceased forebears (*kouvito*). According to those who perform this practice, it allows them to improve their luck and success in life.

The sex of the bird, *ceteris paribus*, does not significantly ($p > 0.10$) affect the price of chicken and guinea fowl. This indicates that consumers are indifferent to the bird's sex when they buy chicken or guinea fowl. However, in other developing countries, the sex of the bird is important when buying chicken. For example, among the Mossi of Burkina Faso (West Africa), a family will give a white cockerel when an agreement for marriage has been reached (Sonaiya and Swan, 2004). In eastern Asia, the female chicken is said to be more beneficial for making soup (especially steamed types) and the meat is said to be tastier (Sonaiya and Swan, 2004).

On the other hand, the sex of the bird has a significant ($p < 0.01$) effect on the price of duck. The price of duck tends to be, *ceteris paribus*, 24% (353 FCFA/kg) higher for a male duck than for a female. This indicates that most consumers are willing to pay a premium for a drake. This can be explained by the requirement of (big) drakes for some ceremonies, particularly in southern Benin where the duck is a component of the dowry.

The *height* of the animal does not have a significant influence on the price of chicken, duck, or guinea fowl ($p > 0.10$).

In contrast, the *meatiness* significantly and positively influences the chicken price ($p < 0.05$). Thus, consumers are willing to pay for this trait, roughly 11.3% more or additional 139 FCFA/kg. The meatiness also positively and significantly affects the price of duck ($p < 0.05$) and guinea fowl ($p < 0.10$). The prices of duck and guinea fowl tend to be 17% (241 FCFA/kg) and 13% (185 FCFA/kg) higher, respectively, for a meaty bird than for a slender bird. The positive influence of the meatiness shows that, although consumers have a preference for indigenous poultry, they prefer meatier birds.

The *age* of chickens has a significant effect ($p < 0.10$) on the price. The price of a chicken aged between 6 and 12 months is, *ceteris paribus*, 11% (135 FCFA/kg) higher than the price for an older chicken. Hence, consumers preferred chickens aged from 6 to 12 months. However, the price of chickens that are younger than 6 months is *ceteris paribus* not significantly different from the price of chickens older than 12 months. This result suggests that selling poultry aged between 6 and 12 months will result in higher returns for the producer (assuming that the gain from higher weights and higher prices *per* kg outweighs the opportunity costs of the livestock capital and the additional production costs, which are quite low in scavenging systems), since consumers offer a higher price premium for this type of chicken. This is in agreement with Aklilu (2007) who found, in Ethiopia, that buyers also look at the age of birds when they buy them for different purposes. Sonaiya and Swan (2004) claim that young birds, notably cockerels up to six months of age with almost one kilogram as live-weight, are usually preferred by consumers. It is also relevant to note that chicks which are a maximum of one month of age are frequently sacrificed to the voodoo god "Tron."

In short, the factors that significantly influence the price of chicken are the breed of the bird, the plumage color, the meatiness, and the age of the bird. Clearly, meatier indigenous chickens with white plumage and aged between 6 and 12 months are preferred by consumers. In other words, consumers are willing to pay a premium for chickens that have these traits. It follows that programs for the improvement of traditional poultry farming should select meatier indigenous chickens that have preferably white plumage. These results also imply that extension services should advise peasants to sell poultry between 6 and 12 months of age.

In addition, meatier drakes and meatier guinea fowl with white plumage are preferred by consumers who are willing to pay a premium for these types

of birds. Accordingly, efforts to improve traditional poultry production should stress traits that are preferred by consumers in order to achieve higher returns for poultry keepers. Chrysostome and Sodjinou (2005) argue that one strategy, which could be used for this purpose in Benin is to select among local birds those which have some desired traits, such as the so-called *Sabouè* chickens (reared mainly in clayey areas in the southern part of Benin), or the *Foulani* chickens (mainly from the northern part of Benin). The *Sabouè* chicken has short legs while the *Foulani* chicken has long legs, but both are appreciated by producers for their performance (high growth rate, high number of eggs laid *per* clutch, easy to market, good sales price, meaty and good live-weight) as well as consumers for the quality of their meat (Chrysostome and Sodjinou, 2005; Tougan *et al.*, 2013a). This strategy of selecting local breeds is probably the most promising, mainly because most village poultry keepers in Benin are reluctant to adopt cockerels of modern breeds (Sodjinou and Henningsen, 2012). The low rate of adoption of modern breeds is, among other things, caused by the consumers' preferences for indigenous breeds and specific plumage colors. Indeed, the "improved cockerels operation" that was implemented by the Government of Benin in order to improve indigenous breeds had the main drawback that the operation introduced new genes that seriously affected the phenotypic diversity, which is strongly valued in rural areas (Chrysostome and Sodjinou, 2005). Thus, chickens with red, white or black plumage that are sought for traditional and ritual ceremonies became rare. Some farmers, therefore, consciously abandoned cockerels of modern breeds or killed them. In addition, the resulting crossbreeds from the first generation were not adapted to traditional poultry rearing practices; consequently the rate of loss was high because of the birds' low level of resistance (Chrysostome and Sodjinou, 2005).

4. Conclusion

The objective of this study was to investigate consumers' preferences for physical traits of bicycle poultry and to explore how research can use information on consumers' preferences to improve the performance of indigenous poultry. Based on field data collected from retailers in four urban and five rural markets in Benin, the study shows that meatier drakes and meatier guinea fowl with white plumage are preferred by consumers who are willing to pay a premium for these types of birds. The factors that significantly influence the price of chicken are the breed of the bird, the plumage color, the meatiness and the age of the bird. In other words, the price of the bird is higher for chickens aged between 6 and 12 months than for younger and older chickens. Consumers are also willing to pay a price premium for birds with specific colors, *e.g.* white plumage (used mainly during various traditional ceremonies). Bicycle poultry is also highly appreciated for its taste and the

³The main breeds used were Rhode Island Red and Plymouth Rock.

low proportion of fat, and consumers are more interested in meatier birds. For this reason, breeding programs that intend to improve local chicken breeds should include traits preferred by consumers, notably the meatiness of the chicken and the color of the plumage. If the costs of producing chickens with these traits are not significantly higher than the costs of producing chickens with traits that are less preferred by the consumers, the production of chickens with these traits could result in higher returns for poultry keepers.

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