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Soybean quality preferences by the Beninese small-scale soy food processors using conjoint analysis

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Soybean is a food crop with a growing interest in Benin. This study aims to provide insight about the main quality characteristics of the grain preferred by small-scale soy processors and the main socio-economic factors which drive their preferences. 116 small-scale processors related to three main soy food products - "Soy Amon" (soy cheese), "Soy Afitin" (soya fermented condiment) and "soymilk" - were asked to express their preferences about important soybean grain properties regarding their activity. Collected data were processed using a conjoint based preference analysis. "Density of the grain" appears to be an important quality criterion for the processors, whatever the soybean food produced. Less important attributes are "use of inoculant", "use of fertilizer", "soybean production origin", "soybean provider", depending on the soy food produced. Moreover, soy Afitin producers dislike soy grain distributed by "individual farmers" and prefer "support organization" as providers, in contrast to soy cheese and soymilk producers. Regarding the social and economic factors influencing the processors' preferences for grain provided by farmers, processors whose main activity is "merchant" are probably not favorable to soy sold by farmers and the higher the purchase frequency is, the more the processor is likely to buy soy from farmers.

Key words: Soybean, grain, small-scale processing, preferences, criteria, conjoint analysis.

INTRODUCTION

Soybean is one of the most consumed plant-based proteins worldwide. Nowadays, soy foods have become a popular choice of many health-conscious people, valued for their versatility, taste, nutritional content, environmental advantages and health benefits (Bolla, 2015). Around the world, soy is processed into different forms and the products derived from it are highly valued: boiled soybeans, soy flour, soy oil, soy sauce, soymilk, soy tofu or amon, soy curds, fried soy curds, fortified soy products for infants and women, fermented soybean and

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others (Bolla, 2015). In the least developed countries like Benin, soybean consumption is suggested in response to the food security issues that poor people are facing (Kpenavoun et al., 2018). Beninese soybean production has increased from 5,000 tons in 2002 to 80,000 tons in 2012 and 99,738 tons in 2014 (INSAE, 2016). Because soybean is a highly nutritious crop with high economic value, there has been a growing interest in its production in Benin as in many other West African countries (Wendland and Sills, 2008). In addition, soy products offer a cheaper source of protein for the low-income population (Floquet et al., 2013). Nowadays, the Beninese government sees soybean value chains as an important economic driver. The artisanal processing of soy is an additional source of income for rural people, and the products derived from soy are very appreciated by consumers. In Benin, the most common products derived from artisanal processing are soy cheese “Amon soja”, soy fermented condiment “Afitin soja” and soymilk “Lait soja”. These activities contribute to improving the livelihood of many rural households across the country. However, processors are facing difficulties to differentiate the soy varieties available on the market, and often buy a mix of varieties for their processing purpose (Hounhouigan et al., 2020). This practice affects the processing efficiency and the quality of the end-product. Using a conjoint based preference analysis, this paper tries to provide insight about the most important quality characteristics and drivers of soybean varieties for the most important artisanal food processing purpose in Benin.

Soy products description

This study focuses on the three most consumed food products from soy sources, which are semi-handcrafted.

- “Soy Amon” is a soy cheese derived from soymilk coagulation, similar to tofu. It is generally valued by low revenue people and urban people who cannot afford other ordinary soy cheese derived from cow milk. It is a ready-to-eat food consumed as a protein source in meals.

- “Soy Afitin” is a fermented condiment made from dehulled and cooked soybean and used as a taste exhauster in the traditional dishes, mainly the sauces. “Afitin soja” is found as is or blended with African locust bean condiment “afitin” and sold in market or along the roads by rural producers.

- “Soymilk”: is a drink derived from ground and heated soybeans, stabilized to be stored in bottles for sale. It is highly appreciated by consumers. It has made arise some new businesses as the interest in it is increasing among both local and foreign people. It has a good potential for rural entrepreneurship.

Conjoint based preference test

To prefer a product is to choose it among various possibilities and proposals. A choice can be difficult to perform or not, but whatever its nature, the individual will almost always adopt the same approach. They will assess the different possibilities available to them based on criteria (which can be very diverse) and choose the one that seems the most adequate to them. When the criteria are quantifiable or logical, the theory of discrete choice models can be used (Bierlaire, 2007). A discrete choice is any choice made from a limited set of mutually exclusive alternatives. The standard microeconomic approach postulates two hypotheses that describe “perfect rationality”. It is firstly assumed that each individual has a full and transitive preference relationship so that all actions can be compared and arranged. Secondly, each individual is assumed to always choose the action they prefer to all others. In contrast, discrete choice models assume that an individual’s choice behavior is not necessarily in accordance with the model of perfect rationality. At the origin of this disagreement, several reasons have been mentioned (Billot and Thise, 1995): the fluctuation during the process assessment, the individual’s ignorance of the state of their preferences, and the error of appreciation.

Several models have been proposed in the literature, to explain factors affecting the buyer’s preference for food. Among these models, the multi-attribute approach is one of the most widely referenced in the literature (Engel and Blackwell, 1982), and seems to be the most suitable for the purpose of soybean varieties choice for processing. The multi-attribute model is derived from a conceptual basis in social psychology (Fishbein, 1967), psychometrics (Torgerson, 1958), and the new economic theory of consumer choice formulated by Lancaster (1966). The model views products as bundles of characteristics and assumes that these characteristics generate utility for consumers. Thus, the preference can be explained by the utility drawn from the characteristics. This implies that the overall utility derived from a product is decomposed into separate utilities, and each pertains to a characteristic (Louviere, 1994). Lancaster’s new consumer economic theory of demand for characteristics provides the theoretical basis of the model of consumer preferences used in this study. Indeed, Lancaster argues that consumers derive utility from the characteristics after the processing of the products into completed meals using labor, time, and perhaps other inputs. Lancaster assumed that g(x) is linear. In addition, he postulates that the technology that transforms a product x into attributes is the same for all consumers. Finally, this study targeted the products that yield common characteristics. This hypothesis corresponds to the separability assumption, usually made in empirical consumer demand analysis (Rao, 2007; Ratchford, 1975). To assess actor preferences, conjoint analysis was used as it is generally

recognized as the most frequently used approach in marketing research for measuring consumers' preferences (Green and Srinivasan, 1978). Conjoint analysis is a statistical technique for decomposing a consumer's preferences into part-worth associated with each attribute of the product. A part-worth can then be recombined in various ways to predict a consumer preference for a product. An alternative approach is the direct analysis of aggregated choice, among experimentally controlled choice sets (Elrod et al., 1992), but it cannot measure part-worth at the individual consumer level. Within conjoint analysis methods, the full-profile method is the most common. According to Green and Srinivasan (1978), it provides a realistic description of the profile and takes into account the potential environmental correlations between factors in real stimuli. The model used to capture the preferences composition is a part-worth model, as it provides greatest flexibility in allowing different shapes for the preference function along each of the attributes, and is also compatible with any arbitrary shape for preference function (Green and Srinivasan, 1978).

Conjoint implementation for soybean processors choice

To express their preference concerning a food product, buyers consider several characteristics, such as its sensory characteristics, its nutritional value and its impact on health (Muchenje et al., 2008, 2009). In contrast to food scientist view of the quality and safety of a product, the buyer conception of the product is more subjective (Katiyo et al., 2020). The quality of food can be broadly divided into two quality attributes: visual quality and eating quality (Pieterse et al., 2019). The former is the determining factor in the consumer's decision to buy a product, while the latter determines whether a consumer will re-purchase a product (Qiao et al., 2002). Another classification attempt is to separate the food characteristics into two categories: intrinsic and extrinsic. Intrinsic cues relate to physical product characteristics (e.g. color, smell, texture) whereas extrinsic cues relate to the product but are not physically part of it (e.g. brand, quality stamps, date label, origin, packaging, production and processing information, price, place of purchase, media information, anecdotes) (Djekic et al., 2018; Font-i-Furnols and Guerrero, 2014). For the purpose of this study, we focus on the visual and both intrinsic and extrinsic characteristics, which are easily valuable by processors in a buying context.

As suggested by Braun and Srinivasan (1975), a preliminary step for a conjoint study is questioning consumers regarding the attributes that are important to them. This usually helps in identifying the attributes that are most frequently regarded as relevant. In this way, focus group discussions as suggested by Kelly (1955) are important in building consensus around actors' preferred traits but it may hide individual preferences that are important in various choices. Focus group discussion and literature review are used to identify the most important traits for each category of actors. There could be two possibilities for the conjoint: rating or ranking based conjoint and direct choice based conjoint. Rating or ranking format uses a model in which individual-level models are fit to ratings of full profiles. Direct choice format estimates an aggregate multinomial logit model using choice data (Louviere and Woodworth, 1983). In this study, the focus group discussion was complemented by individual interviews for ranking and scoring of preferred varietal traits (Bellon, 2006).

MATERIALS AND METHODS

Area of the study

The area of the survey is in the central part of Benin, mainly in the municipality of Bohicon where all actors are concentrated. The interviews were conducted with the three categories of processors (soy Afitin, soy cheese and soymilk). Firstly, a focus group with each category of actors cited above, was organized to identify the most important attributes for each category of producers. Secondly, a structured interview was held, with a sample of 116 processors (58 soy cheese producers, 21 soymilk producers and 37 soy Afitin producers) randomly selected from a list of cooperatives. The interview was conducted in two steps. The first category of questions was related to general socio-economic and demographic information and a second category was related to the preferences. At this step, the soybean profiles were presented to respondents, who were asked to express their opinion and to rate each profile according to their preference. For the preference assessment, a 3-level Likert scale was used, with level 1 for less preferred, 2 for middle preferred and 3 for most preferred. For the rating, processors were asked to value the profile from 0 to 10, the level 0 representing the lowest score and the level 10 the highest score. The respondents' distribution by municipality is indicated in Table 1.

Experimental design

A final validating survey was conducted, consisting in focus groups with each category of actors, in order to confirm the data collected before. The focus group run with the key actors suggested that eight attributes can possibly influence variety choice by actors. These are summarized in Table 2.

For the conjoint data collection, two methods are usually used: the two-factor-at-a-time procedure, and the full-profile approach. In this study, the full-profile method seems to be ideal as it utilizes the complete set of factors. A profile can be defined as a hypothetical soy variety, which can be described on a card, using pictogram or verbal description. According to Green and Srinivasan (1978), the main argument that seems to favor the full-profile approach is that it gives a more realistic description of the variety by defining the levels of each of the factors and possibly taking into account the potential environmental correlations between factors in real stimuli. The use of the full profile allows generating 72 cards according to the formula:

$$2^3 \times 3^2 = 72 \quad (1)$$

with all effect/interaction captured, distributed in 4 blocks of 18 profiles.

Table 1. Processors distribution by municipality.

Municipality (locality)	Number of respondents	Category
Bohicon (Saclo)	19	Soy Afitin producers
Agbangnizoun (Saclagon)	18	Soy Afitin producers
Zogbodomey (Hlanhosssougon)	28	Soy cheese producers
Bohicon (Zakpo)	21	Soy cheese producers
Zakpota (Lokoli)	9	Soy cheese producers
Zogbodomey (Haya)	19	Soymilk producers

Table 2. Attributes and their levels.

Attribute	Level
Grain density	Heavy or light
Production origin	Holli, North or Other
Providers	NGO, Market or Farmers
Use of inoculants during production	Yes or No
Use of chemical fertilizer during production	Yes or No

Data analysis method

The utility values and the scores were estimated using the SPSS 23 software's conjoint command. An analysis of variance and a Turkey post-hoc test were performed to assess the differences between the groups of processors preferences. The social, economic and demographic factors which affect processors' purchase intent were investigated using a probabilistic model also called probit model (Chalwe, 2011). It allows appropriate estimation for the investigation of the effects of explanatory variables on dichotomous dependent variables (Amemiya, 1981). The model is a popular specification of a generalized linear model, using the probit link function and generally specified as:

$$\Pr(Y = 1|X = x) = \Phi\,(X'\beta) \quad (2)$$

where β is a parameter to be estimated, and Φ is the standard normal cumulative distribution function (cdf). The probabilities of probit models lie between 0 and 1 and they compel the disturbance terms to be homoscedastic (Chalwe, 2011). The underlying model is:

$$Y_i * = \alpha + \beta_1 X_1 + \varepsilon_i \quad (3)$$

where ε is the error term, with N (0,δ), α and β are parameters to be estimated. With a realization that

$$Y_i = 1(Y * > 0) = \begin{cases} 1\ if\ Y_i * > 0 \\ 0\ otherwise \end{cases} \quad (4)$$

Yi = 0 if Yi* ≤ 0, and Yi = 1 if Yi* > 0. It follows that

$$P(Y_i = 1) = P(Y_i^* > 0) = P(\alpha + \beta_1 X_i + e_i > 0) \quad (5)$$

For soybean processors, the purchase intent from producers is modeling as a binary decision (1=favorable or 0=not favorable). β is the set of parameters to be estimated, which reflect the impact of changes in x on the probability of selling or not and channel choice decision and ε is the independently distributed error term assumed to be normal with zero mean and constant variance. Based on the literacy of factors that influence consumer preferences and the results of the group discussion with processors, the following dependent variables were used: Merchant as main activity (Mermain), Household size (Hsize), monthly revenue (mrevenue), part of revenue allocated to soybean processing activity (Prevenue), the price (Price), the frequency of soybean purchase (Frequency), the education level (education) and the credit (Credit). In summary the model can be specified as follows:

$$Y_i = X_1 + X_2\text{Mermain} + X_3\text{Hsize} + X_4\text{mrevenue} + X_5\text{Prevenue} + X_6\text{Price} + X_7\text{Frequency} + X_8\text{education} + X_9\text{Credit} \quad (6)$$

Where Y_i= probability to purchase soy from farmers.

RESULTS

Soy processors' preferences

The utility values obtained for each attribute are presented in Table 3. For soy Afitin producers, the desired soybean should be: no inoculant used (0.16), with high density (0.715), coming from the North of the country (0.036), distributed by NGO (0.018) and with no chemical fertilizer used (0.026). As far as (soy cheese) producers are concerned, the ideal soybean should be with inoculants used (0.014), high density (0.708), originate from the North (0.016), distributed by producers (0.026) and with no fertilizer used (0.016). For soymilk producers, the characteristics of a good soybean are: with inoculant used (0.006), with high density (0.674), coming from elsewhere (0.012), distributed by producers (0.012) and with no fertilizer used (0.073). The Kendall coefficient W is high for the 3 groups, respectively 0.715, 0.656 and 0.73 for soy Afitin producers. soy Amon producers and soymilk producers (Table 4). This shows a good

Table 3. Utility estimations for the quality attributes.

Attribute	Level	Utility estimation		
		Soy Afitin producers (N= 37)	Soy cheese producers (N=58)	Soymilk producers (N=21)
Inoculant	Yes	-0.016(0.01)	0.014 (0.007)	0.006 (0.012)
	No	0.016 (0.01)	-0.014 (0.007)	-0.006 (0.012)
Density	High	0.715 (0.011)	0.708 (0.008)	0.674 (0.013)
	Low	-0.715 (0.011)	-0.708 (0.008)	-0.674 (0.013)
Origin	Holli	-0.016 (0.013)	0.003 (0.01)	0.007 (0.017)
	North	0.036 (0.014)	0.013 (0.01)	0.005 (0.017)
	Elsewhere	-0.02 (0.014)	-0.016 (0.01)	-0.012 (0.017)
Distribution	NGO	0.018 (0.014)	-0.002 (0.01)	0.02 (0.017)
	Market	-0.001 (0.013)	-0.024 (0.01)	-0.008 (0.016)
	Producer	-0.017 (0.015)	0.026 (0.011)	-0.012 (0.018)
Fertilizer	Yes	-0.026 (0.009)	-0.016 (0.007)	-0.073 (0.011)
	No	0.026 (0.009)	0.016 (0.007)	0.073 (0.011)

Value in parenthesis () are standard deviations

Table 4. Utility scores.

Attribute	Utility scores		
	Soy Afitin Producers (N= 37)	Soy cheese Producers (N=58)	Soymilk Producers (N=21)
Inoculant	6.458	5.978	6.835
Density	73.493	76.581	71.213
Origin	7.064	6.221	7.6
Distribution	5.681	6.06	5.322
Fertilizer	7.303	5.16	9.031
Kendall test	w= 0.715 ; P=0.001	w= 0.656; P= 0.001	w= 0.73; P=0.001

concordance in the ranking of each group with p-values significant at 1%. It appears that the grain density is the most valuable criteria for the three groups with the scores of 73.493, 76.581 and 71.213 respectively for soy Afitin producers, soy Amon producers and soymilk producers.

Differences among processors' preferences

The ANOVA test results (Table 5) show no difference in the preferences expressed for inoculants, density, origin, chemical fertilizer among the three actors groups. Meanwhile for distribution, some differences occurred (Prob <0.05), with a specific difference between (soy cheese) and soy Afitin producers (estimated marginal means 0.03247; p<0.05) (Table 6). Soy cheese producers like soy distributed by farmers, contrary to soy Afitin producers who dislike it and prefer the one provided by the NGOs. Soymilk producers are also favorable to soybean coming from farmers.

Factors influencing the processors' preferences for grain provided by farmers

The model estimation results (Table 7) show a global significance (p<0.05) with a high pseudo R2= 65,98. Merchant as main activity (p<0.01) and the frequency of soybean purchase (p<0.05) appears to have a significant influence on the preferences. Indeed, processors whose main activity is "merchant" are probably not favorable to soy sold by farmers (B= -0.508 (0.291)) and the more frequency of purchase is high, the more the processor is likely to buy soy from farmers (B=0.347 (0.179)).

DISCUSSION

The density of soy grain is an important criterion for soybean processors' choice. It is highly valued mainly because of the positive correlation between the grain density and the matter yield after grinding. Wu and

Table 5. Differences between processors' choices.

Characteristics	Level	F	dif1	dif2	p-value	Sum of squares
Inoculant	No	1.292	2	114	0.279	0.02
	Yes	1.292	2	114	0.279	0.02
Density	Low	0.157	2	114	0.855	0.18
	High	0.157	2	114	0.855	0.18
Origin	Holli	1.959	2	114	0.146	0.573
	North	1.528	2	114	0.221	0.744
	Elsewhere	0.054	2	114	0.948	0.627
Distribution	NGO	0.47	2	114	0.626	0.477
	Market	1.469	2	114	0.235	0.33
	Farmers	3.825	2	114	0.025**	0.373
Chemical fertilizer	No	2.272	2	114	0.108	0.776
	Yes	2.272	2	114	0.108	0.776

N= 116; ** Signification at 5% level.

Table 6. Results from Tukey post-tests comparing the differences between groups of the significant attributes from the ANOVAs.

Attribute	Level	(I) Processors	(J) Processors	Marginal means (I-J)	Standard error	Probability
Distribution	Farmers	Soy cheese producers (I)/	Soy Afitin producers (J)	-0.03247*	0.01185	0.019
		Soy cheese producers (I)/	Soymilk producers (J)	-0.00729	0.01423	0.866
		Soy Afitin producers (I)/	Soymilk producers (J)	0.02519	0.01534	0.232

*The mean difference is significant at 1% level; N= 116.

Table 7. Determinants of processors preferences for oy grain provided by farmers.

Variable	Coefficient	Error-type
Mermain	-0.508*	0.291
Hsize	0.034	0.055
Mrevenue	0.000	0.000
Prevenue	0.001	0.002
Price	0.000	0.000
Frequency	0.347**	0.179
Education	0.062	0.165
Credit	0.094	0.271

*, ** Significant at 1 and 5% levels, respectively; N= 116.

Bergquist (1991) and Schuler et al. (1995) confirm the relation between wheat and corn grain weight/density and the flour quantity. Thus, as processors are seeking the highest possible revenue, the more volume the ground soy has, the more money they gain. The scores obtained for the other characteristics are low. However, they have a relative influence on the processors' choices. These characteristics are related to the type of fertilizer used, the region of origin of the grain and the supplier. Soy Afitin producers are refractory to soybean with inoculant

while soymilk and soy cheese producers are seeking that. The three groups of processors dislike soy grown with chemical fertilizers. In fact, farmers often combine the inoculant and NPK fertilizer to boost the yield. The combination of inoculant and phosphate fertilizer appears to have a positive effect on grain yield (Agnoro, 2008), and the nitrogen fertilizer is proved to potentially improve the soybean productivity with no effect on the grain quality characteristics (protein, oil and fibre) (Sawyer and Barker, 2013). However, the effect of the combination of the NPK and the inoculant is not well documented. We rely on the processor's observation and postulate that the NPK has a negative effect on the three end-products' quality. As far as region of origin of the soy is concerned, soy Afitin and soy cheese producers appreciate soy coming from the north of the country and soymilk producers prefer soy coming from elsewhere. This preference is related to the quality of the grain which is strongly related to the quality of the soils. Indeed, in the southern and central parts of the country, the soils have very low cation exchange capacities and are therefore poor compared to the north of the country (Igue et al., 2013). It appears that there is not a significant difference between the processors' preferences of the characteristics, except for the supplier "Farmers". In fact, soy Afitin producers dislike soy grain distributed by farmers and prefer NGO sources, in contrast to soy cheese and soymilk producers. According to de Jonge et al. (2008), a higher level of trust in institutions and organizations is associated with a higher level of confidence into the product.

Moreover, the consumers compensate the lack of knowledge they have about the cultivation and production process of foods by trusting actors of the food chain (such as farmers, retailers and manufacturers) as well as regulatory (Berg, 2004; Green et al., 2003; Siegrist and Cvetkovich, 2000; Van Kleef et al., 2006). The results reveal a trust of soymilk and soy cheese processors into farmers, which could be explained by the strong social relationships between farmers and processors. Soy Afitin producers meanwhile, have a high quality exigence, which could only be fulfilled by the NGO trust. This is probably because they have been supported for a longtime by some NGO's and finally built a strong trust relationship with them. The main activity "merchant" and the "frequency of purchase" appear to have a significant effect on the processor's choices. These results are in adequation with the findings of Suwannaporn and Linnemann (2008) about the importance of marketing activity for the rice type consumption and those of Laizer et al. (2018) about the frequency of purchase importance for the rice grain choice for consumption. In contrast, this is not in adequation with the findings of Priyadharsini et al. (2017) who found that household size, education and price are the main factors which influence the preferences for protein products such as soymilk and meat.

Although all the above cited aspects are important to consider in order ensuring the availability of appropriate soy grain for processors, the importance of the extension processes should not be neglected. Indeed, the goals of extension are to transfer knowledge from researchers to farmers, to advise the latter farmers in their decision making and to educate them on how to make better decisions, to help them clarify their own goals and possibilities (Van den Ban and Hawkins, 1996). In most cases, the "Non-farmers innovators" (Researchers) do not provide new technologies with adapted extension tools that can help farmers apply them to improve their productivity (Mgumia, 2004). In the case of soy grain usage for small-scale processing in Benin, the extension service, which is mainly composed of public services and NGOs, should act after a breeding process to disseminate the new varieties. Conservation is also an important step for the final quality of the grain. However, soy grain is less exigent in storage condition than other food crops. Also, the dose of fertilizer could influence the grain conservation. This will probably be investigated by further studies.

Conclusion

Soy food producers are mainly seeking varieties with high grain density and no chemical fertilizer used. Depending on the type of end product, there are differences between the preferences for the other attributes. However, the differences are significant only for the supplier attribute "Farmer": soy Afitin producers dislike soy grain distributed by farmers and prefer NGO sources, in contrast to soy (soy cheese) and soymilk producers. As perspectives, further studies should be oriented to a better understanding of the effect of NPK, Nitrogen fertilizer and inoculant on soy food products. Efforts in the framework of these activities in Benin should be oriented to the promotion of high-density varieties with a low use of chemical fertilizer. At last, since the physical characteristics of soy food are difficult to distinguish, effort should also be made for varietal zoning, to allow processors easily find the suitable grain for their activities. To such end, research should be made to establish the link between the physical properties and the technological characteristics of the varieties. Afterwards, there should be a package of actions to be implemented, starting from a breeding system to the extension and validation of the new varieties by processors to ensure the availability of the most suitable and homogeneous grains for the soybean food processors in Benin.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Agnoro M (2008). Effet de l'inoculation avec "Bradyrhizobium

japonicum" et de l'apport de phosphore sur la productivité du soja (Glycine max) en champs paysans au Bénin. Master Thesis. University of Abomey-Calavi, Benin.
Amemiya T (1981). Qualitative Response Model: A Survey. Journal of Economic Literature 19(4):1483-1536.
Bellon M (2006). Crop research to benefit poor farmers in marginal areas of the developing world: a review of technical challenges and tools. CAB Reviews. Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 1(70):1-11. Available at: https://doi.org/10.1079/PAVSNNR20061070
Berg L (2004). Trust in food in the age of mad cow disease: A comparative study of consumers' evaluation of food safety in Belgium, Britain and Norway. Appetite 42(1):21-32.
Bierlaire M (2007). Modélisation et simulation du comportement - Modèles de choix discret. Doctoral and Polytechnic School of Lausanne/ Laboratoire Transport et Mobilite - EPFL. Available at: https://transp-or.epfl.ch/documents/slidesLectures/IMLPARIS07.pdf
Billot A, Thisse JF (1995). Modèles de choix individuels discrets : théorie et applications à la microéconomie. Revue Economique 46:921-930.
Bolla KN (2015). Soybean Consumption And Health Benefits. International Journal Of Scientific and Technology Research 4(07):50‑53.
Braun MA, Srinivasan V (1975). Amount of Information as a Determinant of Consumer Behavior Towards New Products. Stanford University. Graduate School of Business.
Chalwe S (2011). Factors Influencing Bean Producers' Choice Of Marketing Channels In Zambia Master Thesis. University of Zambia. Available at: http://crsps.net/wp-content/downloads/Dry%20Grain%20Pulses/Inventoried%206.8/4-2011-12-127.pdf
de Jonge J, van Trijp JCM, van der Lans IA, Renes RJ, Frewer LJ (2008). How trust in institutions and organizations builds general consumer confidence in the safety of food: A decomposition of effects. Appetite 51(2):311‑317.
Djekic I, Smigic N, Glavan R, Miocinovic J, Tomasevic I (2008). Transportation sustainability index in dairy industry – Fuzzy logic approach. Journal of Cleaner Production 180:107‑115.
Elrod T, Louviere JJ, Davey KS (1992). An Empirical Comparison of Ratings-Based and Choice-Based Conjoint Models. Journal of Marketing Research 29(3):368‑377.
Engel JF, Blackwell RD (1982). Consumer Behavior. The Dryden Press series in marketing (4th ed.). Chicago: The Dydren Press. pp 740.
Fishbein M (Ed.) (1967). Readings in attitude theory and measurement. New York: John Wiley & Sons, Inc. P 499.
Floquet A, Vodouhe GT, Michaud A, Bridier B, Vodouhe S (2013). How innovation processes unfold along unexpected trajectories -the case of Soy in Benin. Innovation in smallholder farming in Africa: recent advances and recommendations 29:105. Available at: https://www.researchgate.net/profile/Anne-Floquet/publication/259998967_How_innovation_processes_unfold_along_unexpected_trajectories_-the_case_of_Soy_in_Benin/links/576415b208aeb4b9980047f3/How-innovation-processes-unfold-along-unexpected-trajectories-the-case-of-Soy-in-Benin.pdf.
Font-i-Furnols M, Guerrero L (2014). Consumer preference, behaviour and perception about meat and meat products: An overview. Meat Science 98(3):361‑371.
Green JM, Draper AK, Dowler EA (2003). Short cuts to safety: Risk and 'rules of thumb' in accounts of food choice. Health, Risk and Society 5(1):33-52.
Green PE, Srinivasan V (1978). Conjoint Analysis in Consumer Research: Issues and Outlook. Journal of Consumer Research 5(2):103‑123.
Hounhouigan MH, Kounouewa KMG, Ayesiga C, Ingenbleek PTM (2020). Sojagnon: shaping the Beninese soy system to meet the challenges of an emerging market. International Food and Agribusiness Management Review 23(1):143‑156.
Igue AM, Saidou A, Adjanohoun A, Ezui G, Attiogbe P, Kpagbin G, Gotoechan-Hodonou H, Youl S, Pare T, Balogoun I, Ouedraogo J (2013). Evaluation de la fertilité des sols au sud et centre du Bénin. Bulletin de la Recherche Agronomique du Bénin Bulletin de la Recherche Agronomique du Bénin, 12-23. Available at : http://www.slire.net/download/1798/igue_et_al._evaluation_fertilit_.pdf
Institut National de la Statistique et de l'Analyse Économique (INSAE) (2016). Statistiques économiques. Available at: https://www.insae-bj.org/statistiques/statistiques-economiques
Katiyo W, Coorey R, Buys EM, Kock HL (2020). Consumers' perceptions of intrinsic and extrinsic attributes as indicators of safety and quality of chicken meat: Actionable information for public health authorities and the chicken industry. Journal of Food Science 85(6):1845‑1855.
Kelly GA (1955). The psychology of personal constructs. Volume 1: A theory of personality. WW Norton and Company.
Kpenavoun SC, Okry F, Santos F, Hounhouigan DJ (2018). Efficacité Technique Des Producteurs De Soja Du Bénin. Annales des Sciences Agronomiques 22(1):93-110.
Laizer JS, Baharanyi NR, Zabawa R, Kadigi RMJ (2018). Determinants of Consumer Preference for and Expenditure on Rice in the Kilimanjaro Region, Tanzania. Professional Agricultural Workers Journal 6(1):28-41. Available at: https://tuspubs.tuskegee.edu/cgi/viewcontent.cgi?article=1116&context=pawj
Lancaster KJ (1966). A New Approach to Consumer Theory. Journal of Political Economy 74(2):132-157.
Louviere JJ (Ed.) (1994). Conjoint analysis Conjoint Analysis" in. Advanced methods of marketing research pp. 223-259.
Louviere JJ, Woodworth G (1983). Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data. Journal of Marketing Research 20(4):350-367.
Mgumia AH (2004). Tanzanie : Transmettre les connaissances locales sur l'agriculture. In. Banque Mondiale (Ed.) Les Connaissance autochtones : Connaissances locales pour un développement global Banque Mondial pp. 201-204. Available at : http://documents1.worldbank.org/curated/en/921291468313849970/pdf/307350FRENCH0ik0local0pathways.pdf
Muchenje V, Dzama K, Chimonyo M, Strydom PE, Hugo A, Raats JG (2008). Sensory evaluation and its relationship to physical meat quality attributes of beef from Nguni and Bonsmara steers raised on natural pasture. Animal 2(11):1700‑1706. DOI: https://doi.org/10.1017/S1751731108002802
Muchenje V, Dzama K, Chimonyo M, Strydom PE, Raats JG (2009). Relationship between pre-slaughter stress responsiveness and beef quality in three cattle breeds. Meat Science 81(4):653‑657.
Pieterse E, Erasmus SW, Uushona T, Hoffman LC (2019). Black soldier fly (Hermetia illucens) pre-pupae meal as a dietary protein source for broiler production ensures a tasty chicken with standard meat quality for every pot. Journal of the Science of Food and Agriculture, 99(2):893‑903.
Priyadharsini S, Kathiravan G, Thirunavukkarasu M, Ganpat W, Saravanakumar D (2017). Ordered Probit Analysis of Consumers' Preferences for Soymilk and Meat Quality Attributes in the Emerging Cities of Southern India. Expert Journal of Marketing 5(2):37‑43.
Qiao M, Fletcher DL, Smith DP, Northcutt JK (2002). Effects of Raw Broiler Breast Meat Color Variation on Marination and Cooked Meat Quality. Poultry Science 81(2):276‑280.
Rao RV (Ed.) (2007). Developments in conjoint analysis: marketing decision models. Boston, MA: Springer.
Ratchford BT (1975). The New Economic Theory of Consumer Behavior: An Interpretive Essay. Journal of Consumer Research 2(2):65‑75.
Sawyer JE, Barker DW (2013). Seasonal and Rotational Influences on Corn Nitrogen Requirements. Iowa State Research Farm Progress Reports. Available at: https://lib.dr.iastate.edu/farms_reports/1919
Schuler SF, Bacon RK, Finney PL, Gbur EE (1995). Relationship of Test Weight and Kernel Properties to Milling and Baking Quality in Soft Red Winter Wheat. Crop Science 35(4):949‑53.
Siegrist M, Cvetkovich G (2000). Perception of hazards: The role of social trust and knowledge. Risk Analysis 20(5):713-719.
Suwannaporn P, Linnemann A (2008). Consumer Preferences and Buying Criteria in Rice: A Study to Identify Market Strategy for

Thailand Jasmine Rice Export. Journal of Food Products Marketing 14(4):33‑53.
Torgerson WS (1958). Theory and methods of scaling. New York: J. Wiley.
Van den Ban AW, Hawkins HS (Eds.) (1996). Agricultural Extension. Oxford, Malden, MA: Blackwell Science.
Van Kleef E, Frewer LJ, Chryssochoidis G, Houghton JR, Korzen-Bohr S, Krystallis, Lassen J, Pfenning U, Rowe G (2006). Perceptions of food risk management among key stakeholders: Results from a cross-European study. Appetite 47:46–63
Wendland KJ, Sills EO (2008). Dissemination of food crops with nutritional benefits: Adoption and disadoption of soybeans in Togo and Benin. Natural Resources Forum 32(1):39‑52.
Wu YV, Bergquist RR (1991). Relation of Corn Grain Density to Yields of Dry-Milling Products. Cereal Chemistry 68(5):542−544.