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## Towards Validating Moringa's Nutraceutical Benefits: An Examination of Consumers' Perspectives vis-à-vis Health Benefits Efficacy and Willingness to Pay

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### Abstract

This study examined the validity of claimed Nutraceutical benefits of *Moringa oleifera* products through the lens of consumers' perceptions and Willingness to Pay (WTP) for perceived benefits. Data were randomly collected from 120 sampled Moringa consumers. Results indicate that knowledge of *Moringa oleifera*'s benefits is high among respondents and Moringa is consumed for various preventive and curative purposes. On the average, respondents were willing to pay about 5% over and above the current price of Moringa product so as to have access to perceived product's Nutraceutical benefits. WTP was found to be significantly influenced by perception of efficacy of product's benefits ( $p = 0.01$ ), education ( $p = 0.02$ ) and occupation of respondents ( $p = 0.03$ ). The study emphasizes the need for further clinical and pharmacological double-blind placebo test trials to ascertain the acclaimed therapeutic benefits of the product.

### Key words

Nutraceutical benefits, willingness to pay, double-blind placebo clinical trials.

### Introduction

*Moringa oleifera* or simply Moringa is the most widely cultivated of the 13 different species of the family Moringaceae or Horseradish tree (Fahey, 2005). It has been identified to contain several nutritional and therapeutic properties which make it ideal for combating malnutrition and certain health related disorder. Many sources reveal that, for each equal weight, Moringa leaves contain more beta-carotene than carrots, more iron than spinach, more potassium than bananas, more vitamin C than oranges and more protein than peas (Palada, 2003). In addition, Moringa contains a unique blend of phytochemicals which may have an impact on health but are not required by humans as essential nutrients (Fahey, 2005), and a group of compounds called glucosinolates and isothiocyanates which are reported to have hypotensive, anticancer and antibacterial effects (Fahey, 2005; Siddhuraju and Becker, 2003).

For centuries, these nutritional and therapeutic properties have been utilized in the traditional

treatment of several health disorders in various cultures (Saint Sauveur, 2001). Fahey (2005), made a review of the medical uses of Moringa and identified several curative and preventive usages ranging from asthma, cancer, immunity build up and skin disorder to digestive disorders (Fahey, 2005).

However, the validity of these claims is undermined among scientific and medical communities and unsurprisingly, disclaimer notices are placed on some Moringa websites that denounce the therapeutic claims of the product (Schneemann, 2011). This contrast between conventional western medical opinion and claims by practitioners of traditional/herbal medicine could be as a result of the approach used in verifying these medicinal claims. Medical professionals have been observed to focus more narrowly on a medical model of health care (a history and examination) followed by investigation and treatment, and finally clinical measures of successful outcome (Detmar et al., 2002). While the sole application of this method in justifying the usefulness of a drug is faulted

in certain quarters (Detmar et al., 2002), modern medicine is slowly beginning to recognize the importance of patient/consumer perspectives to health care delivery with more emphasis placed on the understanding of the importance of the inter-relationships among health needs, satisfaction, and quality of life.

Furthermore, within the prism of consumer behavior theory the decision to consume a marketable commodity is influenced by the utility or satisfaction such a good provides which is could translate as their willingness to pay for such a good. This could be due to the goal of utility maximization pursued by all rational consumers and, expectedly, demand might be placed on a particular product after such is perceived to maximize utility or satisfaction. Several studies have identified perceived quality as a strong determinant of patients' choice of health provider and willingness to pay (Akin and Hutchinson, 1999; Annis, 1981; Masatu, et al., 2001; Newman, et al., 1998).

Within these contexts and given the increasing consumption of the Moringa product worldwide and locally in Nigeria, as well as the growing attention from various institutional, scientific and industrial bodies involved in the development of this product, the objectives of this study were to;

- examine respondents' knowledge of nutritional and therapeutic use of Moringa,
- identify consumers' Nutraceutical and therapeutic choice(s) of Moringa uses
- examine consumers' perceptions of Nutraceutical and therapeutic efficacy of Moringa,
- determine consumers' willingness to pay (WTP) for Moringa benefits, and,
- assess the determinants of consumers' willingness to pay for Moringa perceived health benefits

The study is justified on two grounds. First, with the current emphasis on the patient as a consumer, pharmaceutical manufacturers are increasingly interested in obtaining feedback about their product from patients. Showing greater satisfaction with a product provides a marketing advantage and the feedback can also be used to further improve products. There is also the inference that increased satisfaction will lead to increased adherence, better clinical outcomes and reduced healthcare expenditures, but literature to support these

associations are rare hence this study would upgrade existing literatures. Second with conflicting claims and counterclaims on the validity of health benefits of Moringa, this study could initiate rekindled interest in the clinical assessment of Moringa's health benefits.

## **Materials and methods**

The study was conducted in Kwara State, Nigeria. Kwara State is located in the North-Central geographical zone of Nigeria within latitudes 70°45' and 90°30'N and longitudes 40°30' and 60°25'E. The state has two main climatic seasons; the dry and wet seasons which make it well suited for the cultivation of the Moringa crop. The state equally hosts several educational and research institutes committed to the development of the Moringa crop. University of Ilorin which is located in the state's administrative headquarters is one of such educational institutes engaged in the development of the Moringa crop both for consumption and research purposes.

The sampling technique for this study involved the random sampling of Moringa consumers who had purchased Moringa product for consumption within the past six month from the date of the survey. The sample list was generated from the marketing outlet of the University of Ilorin Moringa Plantation where consumers purchase the Moringa product. Overall, 120 questionnaires were administered in an interview schedule conducted in July, 2012 on each respondent.

We pre-tested the questionnaire by initially administering it on a pilot sample of 10 persons in the way and manner suggested by Aaker and Day (1986) and used by DiPasquale (2012). Thereafter, the questionnaire was redesigned to reflect some observations pointed out during the pre-test stage. Overall, the questionnaire was found relatively easy to understand by respondents and respondents reported finding it interesting to complete.

### **1. Analytical framework**

This study employed descriptive statistics, four-point Likert scale, Ordered Logistic Regression and the Binary Logistic Regression to achieve the stated objectives.

### **2. Exploratory analysis**

A four-point Likert scales was used to obtain participant's preferences or degree of agreement with a set of statements that examined perceptions

of the Nutraceutical benefits of Moringa. Specifically, Respondents were asked to indicate their level of agreement with the effectiveness of the Nutraceutical benefits of the Moringa product in a given statement by way of an ordinal scale. The four-point scale ranged from “Strongly Disagree” and “Strongly Agree” on one end, to “Neither” in the middle, and agrees or disagrees at the quartile points on the scale. Each Individual response was treated as an ordinal data because although the response levels do have relative position, we cannot presume that participants perceived the difference between adjacent levels to be equal a requirement for interval data. Doing otherwise, from a statistical standpoint could be dangerous as there is no way to ensure that participants view the difference between “agree” and “strongly agree” the same as they might view the difference between “agree” and “neutral.”

The four-point Likert scale data were analyzed with descriptive statistics. The mode was computed as a measure of central tendency for our study because of the nature of the data. We deliberately did not include the mean because adding a response of „strongly agree“ (4) to two responses of „disagree“ (1) would give us a mean of 3, which has no significant meaning to our study.

### 3. Econometric analysis

The Ordered Logistic Regression (OLR) model was applied to estimate some socio-economic characteristics that influenced respondents' responses to each of the four-point Likert response item. Ordinal logistic regression, or PLUM (Polytomous Universal Model), is an extension of the general linear model to ordinal categorical data. Ordinal logistic regression models have been applied over the last few years for analyzing data, the response or outcome of which is presented in ordered categories. Ordered information in score-form has been increasingly used in epidemiological studies, such as quality of life in interval scales, health condition indicators and even for indicating the seriousness of illnesses (Ananth and Kleinbaum, 1997). Depending on the study's purpose, these models also allow the odds ratio (OR) statistic or the probability of the occurrence of an event to be calculated (Anath and Kleinbaum, 1997).

The dependent variable (Y), for this study ranges from 1 to 4, corresponding to four-point scale levels of: (4) strongly disagree, (3) agree, (2) neither agree nor disagree, (1) disagree,

and. If  $P_i$  is the probability for  $Y = i$ , and  $P(Y \leq j) = P_1 + P_2 + \dots + P_j$  represents the probability that a respondent falls in a category less than or equal to the  $j^{\text{th}}$  category ( $j = 1, 2, \dots, 4$ ), then we have a collection of cumulative probabilities for each case. The final category  $P(Y \leq 4)$  has a cumulative probability of 1. Following Zhang, et al., (2010) the OLR model based on the cumulative probability can be specified as:

$$\text{Logistic } [P(Y \leq 1)] = \ln [P_1/1 - P_1] = k_1 - \sum_1^n \beta_i X_i + e \quad (1)$$

$$\begin{aligned} \text{Logistic } [P(Y \leq 2)] &= \ln [P_1 + \frac{P_2}{1} - (P_1 + P_2)] \\ &= k_2 - \sum_1^n \beta_i X_i + e \end{aligned} \quad (2)$$

$$\begin{aligned} \text{Logistic } [P(Y \leq 3)] &= \\ \ln [P_1 + P_2 + P_3/1 - (P_1 + P_2 + P_3)] & \\ &= k_3 - \sum_1^n \beta_i X_i + e \end{aligned} \quad (3)$$

$$P(Y \leq 4) = 1 \quad (4)$$

Where  $\alpha_1, \alpha_2, \dots$  and  $\alpha_5$  are the intercepts,  $\beta_1, \beta_2, \dots,$  and  $\beta_n$  are the coefficients to be estimated, and  $e$  is the error term. For this study,  $X_i$  ranges from  $X_1$  to  $X_5$ . Where  $X_1$  is age of the consumer,  $X_2$  is the gender of the consumer,  $X_3$  is livelihood activity of respondent,  $X_4$  education of the respondent and  $X_5$  is the marital status of respondents. The cumulative model constrains the coefficients in these models to be the same but allows the intercepts to vary (Allison, 1999; O'Connell, 2006).

In order to access the determinants of willingness to pay for the Moringa by-product, a logistic regression model was used for analysis of data obtained, in which the dependent variable used assumes the value of 1 if the consumer declared his willingness to pay more for Moringa by-product based on the satisfaction derived from the product, 0 otherwise. The basic analytical method for studying individual willingness to pay is grounded in consumer behavior theory (Ben-Akiva and Lerman, 1985). The foundation of this theory is the concept that individuals choose from among alternative bundles of goods and services with the objective of maximizing their overall satisfaction, or utility. Consumers may also derive satisfaction not by the good itself but by attributes or characteristics of the good that provide utility (Lancaster, 1966). WTP is the maximum amount of money a consumer would be willing to pay for the new product. These surveys only give

meaningful results if they are properly grounded in a consumer maximization framework (Hanemann and Kanninen 1998).

The formal specification of the model used was as follows:

$$P_i = P\left(Y_i = \frac{1}{x_i}\right) = E\left(Y = \frac{1}{x_i}\right) = \frac{1}{1} + e^{-\beta x_i} = \frac{1}{1} + e^{-z_i} \quad (5)$$

Equation 5 accessed the impact of independent variables on the likelihood that a consumer will consume moringa by-product or not.  $X_i$  is the set of independent variables and, as in standard regression models,  $\alpha$  is the intercept and  $\beta$  is the vector of coefficients for the vector of independent variables.

The explicit function could be denoted using a set of cognitive and socioeconomic factors  $X$ , that could explain the decision to pay. For each respondent,  $j = 1, \dots, N$  in the sample, the latent variable, WTP, can be written as a single bounded model:

$$WTP = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon_j \quad (6)$$

With WTP being a dichotomous variable representing 1, if the respondent is willing to pay more for Moringa by-product, 0 otherwise, and  $X$  being the variables of interest that could influence the decision. For this study,  $X_i$  takes the value from  $X_1$  to  $X_5$  and these include; age, gender, education attainment, livelihood activity and perception of effectiveness of the product.  $\beta$  is the coefficient and  $\epsilon$  is the error term.

## Results and Discussion

### 1. Distribution of respondents' socioeconomic characteristics

The distribution of gender, age, education, marital status and livelihood activities of respondents are presented in Table 1.

As revealed in Table 1, 68% of the respondents are male, the minimum and maximum ages of the respondents are 20 and 63 years respectively and the mean age of respondents is 35 years. Majority (98%) of the respondents are literates, with tertiary education attainment being the modal education by the respondents. About 61% of the respondents are engaged in public and government service as a source of livelihood, while about 17% are artisans and commercial traders, and 6% of the respondents are engaged into farming as a source of livelihood. About 14% of the respondents are students based in tertiary education.

<b>Socio-economic Characteristics (N=120)</b>		
	<b>Frequency</b>	<b>%</b>
<b>Gender</b>		
Male	82	68.3
Female	38	31.7
<b>Total</b>	<b>120</b>	<b>100</b>
<b>Age</b>		
<30	24	20
31-40	33	27.5
41-50	49	40.8
51-60	11	9.2
>60	3	2.5
<b>Total</b>	<b>120</b>	<b>100</b>
Mean age (35yrs)		
Minimum age (20yrs)		
Maximum age (63yrs)		
<b>Highest education attained</b>		
No formal	2	1.7
Adult education	1	0.8
Secondary	8	6.7
Tertiary	104	86.7
Quranic	5	4.2
<b>Total</b>	<b>120</b>	<b>100</b>
<b>Marital status</b>		
Single	38	31.7
Married	78	65
Divorced	4	3.3
<b>Total</b>	<b>120</b>	<b>100</b>
<b>Occupational Activity</b>		
Farming	8	6.7
Public/Government service	74	61.7
Artisans/commercial traders	21	17.5
Tertiary-based students	17	14.2
<b>Total</b>	<b>120</b>	<b>100</b>

Source: Field survey, 2012

Table 1: Distribution of socio-economic characteristics of respondents.

The socio-economic distribution of the study participants reflects the structural characteristics of a population living in close proximity to an university geographic location; majority of the respondents are educated and are involved government-based occupational activity. This is expected, as our sample was drawn from the Moringa consumer list generated from Moringa sales outlet located in the University. Our sample socio-economic characteristic in terms of education, marital status and occupational activity



is comparable to the studies of Theodoropoulou and Petros (2007) and Tesfay et al. (2012) which were conducted in similar study areas.

However a substantial minority of our sample are artisans and farmers who are non-literates and female respondents. This may tend to bias our result in favor of these socio-economic categories as against the general population of active Moringa consumers (Mitchell and Carson, 1989). With this population choice bias, we caution that our findings may not be representative of the population of Moringa consumers.

### 2. Awareness of nutraceutical use(s) of Moringa by-products by respondents

The result of awareness of various Nutraceutical uses of Moringa products by respondents is described in Table 2.

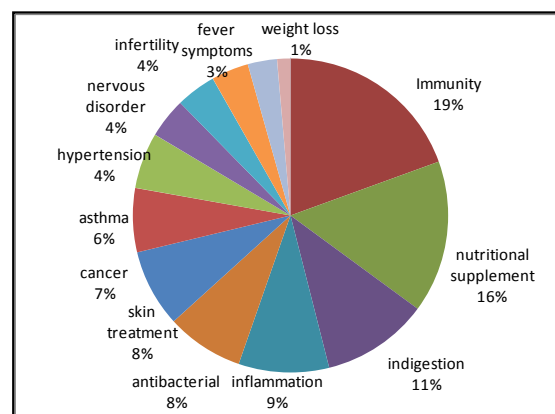
Table 2 indicates that Moringa awareness with respect to immunity build-up was ranked the first with about 74 % of the respondents reporting awareness of Moringa product use for this Nutraceutical purpose. This was followed by awareness as a nutritional supplement which ranked second, and indigestion and antibacterial uses occupying the third position respectively. Other uses include; skin treatment in 4<sup>th</sup> position, fertility and reproductive health related uses in 5<sup>th</sup> position, anti-inflammatory uses in 6<sup>th</sup> position, high blood pressure in 7<sup>th</sup> position, asthma treatment in 8<sup>th</sup> position, nervous disorder in 9<sup>th</sup> position, cancer prevention in 10<sup>th</sup> position, fever symptoms in 11<sup>th</sup> position, weight reduction in 12<sup>th</sup> position, and diabetes in 13<sup>th</sup> position respectively. The result of this finding is unsurprisingly supported with the findings of Saint Sauveur (2001) and Fahey (2005). Specifically, the study of Fahey (2005) made an extensive review of the therapeutic

and health uses of Moringa and identified with the therapeutic and nutritional uses reported in this study.

### 3. Consumers' nutraceutical and therapeutic choice(s) of Moringa use

In addition to identifying consumers' level of awareness of Moringa Nutraceutical benefits (Table 2), the study further identified and ranked the various nutritional and therapeutic uses those consumers actually put Moringa to use for. This is necessary because there might be a gap between what consumer knows and what actually operates with respect to Moringa Nutraceutical benefits.

The result Nutraceutical choices of Moringa products usages by respondents is described in Figure 1.



Source: Field survey, 2012

Figure 1: Distribution of consumers' choice(s) of nutraceutical use of Moringa products.

Figure 1 indicates that consumers' use of Moringa was ranked the first for immunity build up (19%) with about 16 % of the respondents reporting the use of Moringa product for this Nutraceutical purpose. This was followed by use for indigestion (11%).

Use Awareness of Moringa product by Respondents	Freq	%	Rank	Use Awareness of Moringa product by Respondents	Freq	%	Rank
Immunity build-up	89	74.2	1 <sup>st</sup>	High blood pressure	55	45.8	7 <sup>th</sup>
Nutritional supplement	82	68	2 <sup>nd</sup>	Asthma	55	45.8	8 <sup>th</sup>
Indigestion	74	61.7	3 <sup>rd</sup>	Nervous disorder	49	40	9 <sup>th</sup>
Antibacterial	74	61.7	3 <sup>rd</sup>	Cancer	46	38.3	10 <sup>th</sup>
Skin treatment	72	60	4 <sup>th</sup>	Fever symptoms	46	38	11 <sup>th</sup>
Fertility and reproductive health	68	56.7	5 <sup>th</sup>	Weight reduction	38	31.7	12 <sup>th</sup>
Anti-inflammation	58	48.3	6 <sup>th</sup>	Diabetes	24	20	13 <sup>th</sup>

Source: field survey, 2012

Table 2: Perceived nutraceutical awareness and ranking of awareness of Moringa products.

This study is consistent with previous research which underscored the use of the entire parts of Moringa in various culture and tradition for the treatment of these therapeutic disease conditions (Fahey, 2005).

The relative distribution and proportion of Moringa therapeutic use in this study, may however, slightly depart from sources from different regions of the world as the prevalence and epidemiology of disease is a function geographic and socio-economic predisposition of a particular population.

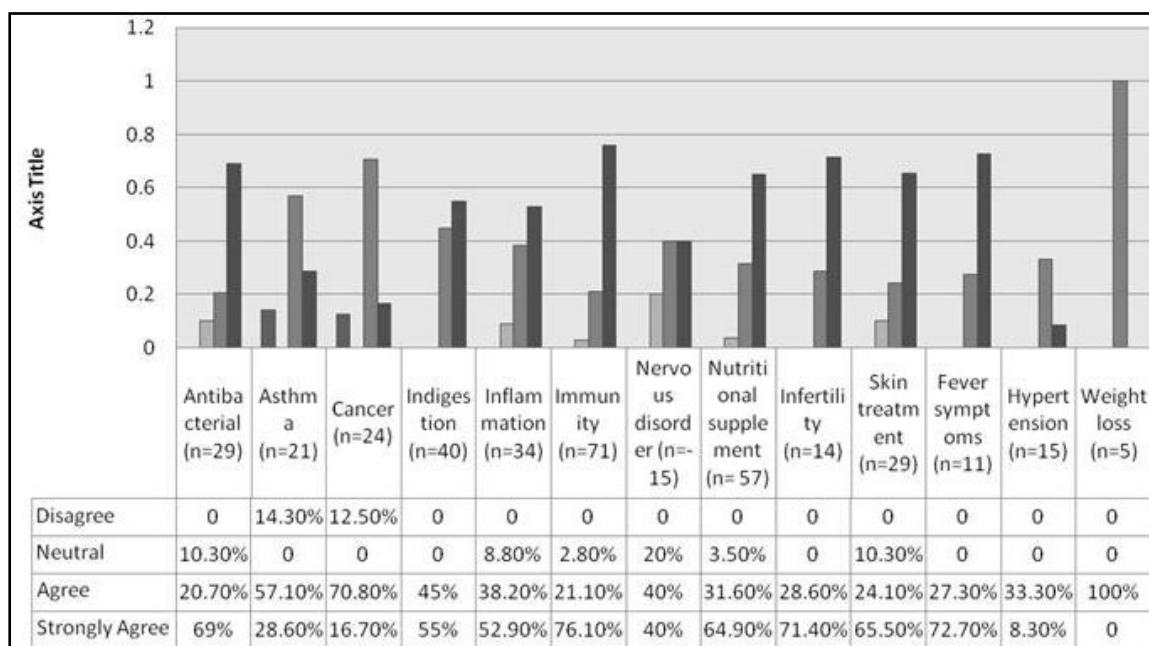
#### 4. Consumers' perceptions of effectiveness of Moringa's nutraceutical benefits

The result of consumers' perception with respect to the efficacy of Moringa in alleviating the symptom conditions for which is was used for is presented in Figure 2.

The result of the perception of respondents with respect to the efficacy of Moringa use in relieving certain disease condition is shown in Figure 2. The result shows that across each use category, majority of respondents indicate 'agree' and 'strongly agree' to the claims and efficacy of Moringa in satisfying the uses it was put to use. "Nether" of which indicates a state of neutrality to the health claim of Moringa was less indicated by

respondents except for antibacterial uses, immunity, nervous disorder, anti-inflammation uses and skin uses. "Disagree" which represents objection to the effectiveness of the purported claims of Moringa product by respondents was sparsely indicated for al use categories except for asthma and cancer. The apparent confidence in the nutritional properties of Moringa as revealed in this study is well supported in several oral and traditional literatures of communities where Moringa is used for health benefit (Fuglie, 1999 and Fuglie, 2000).

However, the validation of this perceptual evidence still requires clinical validation. It is acknowledged that several of Traditional Medicine claims have been validated following the claims of efficacy as attested to by users. For instance, the study of van Agtmael, et al. (1999) validated the use of *Artemisia annua* in treating drug resistant malaria, Le Bars et al. (1997) validated the use of garlic in lowering blood cholesterol and Reginster et al. (2001) validated the use of Glucosamine in the treatment of osteoarthritis. The use of Moringa for therapeutic benefits equally falls within the traditional medicine approach and a need for further clinical trials to validate these claims may be justified.



Source Field survey: 2012

Figure 2: Distribution of respondents' perceptions of the nutraceutical effectiveness of moringa.

Predictor variables	Coef.	Std. Err.	z	P>z
Gender (Male)	-0.9197942	0.3804909	-2.42	0.016***
Age	0.0141688	0.0206388	0.69	0.492
Marital status	0.2227772	0.2716128	0.82	0.412
Highest Education Attained (Tertiary)	0.062647	0.2881585	0.22	0.828
Occupational Activity	0.3781028	0.253344	1.49	0.136

Note:  $p > \chi^2 = 0.01$ \*\*\*  
 pseudo R<sup>2</sup> = 0.33  
 log likelihood = -134.227  
 key: \*\*\*significant at 1%

Table 3: Parameter estimates of the determinants of respondents' perceptions of moringa's effectiveness.

#### 4.1. Socio-economic determinants of respondents perceptions of nutraceutical effectiveness of moringa by-product

The result of the ordered logistic regression is presented in the parameter estimates in Table 3.

The model parameter estimates; the likelihood ratio test as observed by the significance of the  $\chi^2$  at 1 % shows that the model fits well with the predictor variables on it (Table 3). Accordingly, respondents' perception of the Nutraceutical claims of Moringa's was significantly related to gender ( $p < 0.05$ ) holding all other variables constant. Essentially, coefficient for male gender is negative implying that male respondents are less likely to affirm efficacy of Moringa products. Studies have confirmed that biological sex and socio-cultural gender influence stress-related diseases which may subsequently have an impact on response to treatment (Juster and Lupien, 2012; Mora, et al., 2012; Verdank and Kinge, 2012). However, the fundamental basis of the observed sexual dimorphism in perception of Moringa efficacy which may be inherent in the biological differences and/or the interactions of other factors including the differences in the socio-economic characteristic within and between the groups of this sample is unknown and may be the cause of further investigation.

#### 5. Distribution of consumers' willingness to pay for Moringa's processed dried-leaf powder

The distribution of consumers with regards to how much they are willing to pay for Moringa given their perceptions of the health benefits of the product over and above the current price at varying degree of 5%, 10%, 15%, 20%, and 25% increase is presented in Table 4.

According to the Table, about 58% of the respondents would not pay above the current price for the Moringa product used. However, 9.2%,

15%, 10% and 6.75 of the respondents were willing to pay 5%, 10%, 15%, and 25% respectively over and above the current price of their favorite Moringa product so as to have access to the perceived health benefits that the product offers.

Prices Consumers are WTP (N)	Freq	%
Current Price	70	58.3
5% increase	11	9.2
10% increase	18	15
15% increase	13	10.8
25% increase	8	6.7
<b>Total</b>	<b>120</b>	<b>100</b>

Note: Std deviation = 149.98  
 Source: Field survey, 2012

Table 4: Distribution of respondents willingness to pay for Moringa product (100g).

Few published data are available on the price of processed Moringa dried leaf powder in developing countries. Majority of data available through internet sales shows a lot of price differentials [www.siteserver2.co.uk/leonerresources/downloads/moringamarketreview.pdf](http://www.siteserver2.co.uk/leonerresources/downloads/moringamarketreview.pdf). The indication of willingness by respondents to pay a relatively higher price for Moringa at varying amount may be indicative of the satisfaction and/or the relative non-availability of alternative conventional therapies. This finding is supported by similar findings of Marvin et al, 2004 which indicated that consumers are willing to pay higher prices for processed foods that are closely related to Moringa product in terms of nutritional benefits.

#### 6. Determinants of respondents' willingness to pay for moringa's perceived benefits

The logistic regression model parameter estimates of the determinants of respondents' willingness to pay above the current offered price for Moringa by-products are presented in Table 5.



Predictor Variables	Coeff	Std. Err.	Z	P>/z/
Satisfaction with Benefits	1.451185	0.4528996	3.2	0.001***
Gender	0.5376934	0.5016848	1.07	0.284
Age	-0.0000737	0.239783	0	0.998
Marital status	0.0482926	0.3229728	0.15	0.881
Education	0.7797345	0.3546667	2.25	0.025**
Livelihood activities	-1.046816	0.3499478	-2.99	0.003***
Constant	-2.270687	2.074167	-1.09	-6.335

Note: Log likelihood = -62.38, P > chi<sup>2</sup> = 0.01, LR chi<sup>2</sup> (6) = 28, Pseudo R<sup>2</sup> = 0.483,

\*\*\*= significant at 1 %

\*\*=significant at 5%

Source: Field survey, 2012

Table 5: Determinants of respondents' willingness to pay for moringa products.

The model parameter estimates; the log likelihood ratio (LR) test significance at 1% indicates that the model with the predictor variables in it is statistically different from the one with only the constant and suggests the fitness of the model in explaining the predictor variables (chi<sup>2</sup> = 28, p < 0.01, diff = 6). The R<sup>2</sup> of 0.483 indicates that 48% of the variation in consumers' WTP could be attributed the variables in the model and the need for further studies that would capture other variables which could significantly contribute to explaining the variations in the consumers' WTP. According to Table 5, willingness to pay above the current price was found to be significantly related to satisfaction derived from using the product (p = 0.01), education (p = 0.03) and livelihood activities of the respondents (p=0.01).

The result shows that respondents' satisfaction with the health benefits of the product positively (p<0.01) influenced their willingness to pay, holding all other variable constant. This is expected in theory and corroborated by previous literatures. Confidence in the efficacy of the treatment may influence willingness to pay in line with utility maximization theory. Furthermore, the study of Winston and Patel (1995) identified that the primary factor in opting for a traditional medicine is the confidence in the treatment, ease of access, and convenience (Winston and Patel, 1995). The willingness of respondents to pay more for Moringa products due to the perceived health benefits could possibly justify the Nutraceutical claims of the product, however, more clinical trials still need to be carried out to further validate this result and or define the gap between perception and conventional medical (clinical) evidence in case versus control and double blind placebo trials.

Equally, the possession of formal education significantly increased the likelihood of willingness to pay for Moringa product (p<0.05) given that all other variables are held constant. The possession of formal education may have an influence on access to both printed and/or digital information which would subsequently enhance access to information pertaining to the Nutraceutical benefits of Moringa. The interpretation of this information may be of relevance in influencing certain decision pertaining to respondents' willingness to pay. The interpretation of this knowledge is however subjective to each individual consumer disposition to the credibility of the source of the information.

Conversely, respondents engaged in public service likelihood were less likely to pay more for Moringa products in the study area given that all other variables in the model are held constant (p<0.01). This may be because such category of respondents has a relatively higher access to alternative health products and facilities as a result of their institutional affiliations. Or it could equally be as a result of access to subsidized prepaid health schemes as most respondents engaged in public services in the study area are usually involved in government-assisted prepaid health insurance scheme. This may influence their decision not to incur any additional financial cost for the purchase of Moringa as such are not likely to be covered by the health insurance scheme since it is not dispensed in registered health centers.

## Conclusion

The main objective of this study was to explore the validity of claimed Nutraceutical benefits of Moringa through the lens of consumers'

perceptions of its effectiveness in alleviating certain health conditions and to define factors that determine their willingness to pay for access to these benefits. Based on the study's findings, the following conclusion could be drawn from the study:

1. Majority of the consumers are aware of one Nutraceutical benefits or another of Moringa consumption; however, awareness was in varying degrees depending on the type of usage.
2. Majority of respondents consuming Moringa for preventive and treatment of health reasons are satisfied with the product and agree to its effectiveness.
3. The perception of that Moringa is effective in delivering desired Nutraceutical benefits was significantly influenced by gender of respondents. Males were skeptical in expressing satisfaction to efficacy.
4. While the basis of the observed sexual dimorphism in perception of efficacy is unknown, the very fact is instructive for planning product packaging advertising and promotion in a way that caters for this particular differences between gender groups.
5. Respondents are equally willing to pay more at various levels of 5%, 10%, 15% and 25%

over and above Moringa's current price so as to have access to the desired benefits of Moringa products.

6. Willingness to pay was found to be significantly related to consumers' perception of satisfaction derived from using Moringa products, education and working with a government based public service at 5% and 1% level.

From the results of this study, the authors advance the following recommendations:

- i. intensify clinical and pharmacological research to test claims of the therapeutic benefit Moringa;
- ii. marketing should take cognizance of the significant gender and livelihood activity effects on perception;
- iii. a survey of non-adopters may shed additional light on consumer behavior as it relates to claimed health benefits of Moringa;
- iv. the power of the R<sup>2</sup> in the models estimated for the determinants of perceptions and Willingness to Pay calls for additional studies to be undertaken that would identify other factors that could be influence consumers perceptions to product efficacy and WTP.

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