

Research Article

Temesgen Bocher*, Kirimi Sindi, Tawanda Muzhingi, Jean Claude Nshimiyimana, Madjaliwa Nzamwita and Jan Low

Investigating consumer preferences and willingness to pay for Orange-fleshed Sweet potato (OFSP) juice in Rwanda

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Abstract: While micronutrient malnutrition has become a major public health problem in developing countries, consumption of biofortified foods such as orange fleshed sweet potato has proved to be cost effective means of addressing vitamin A deficiency. This paper describes consumer preferences and willingness to pay for Orange fleshed Sweet potato (OFSP) juice based on a structured survey and taste tests administered to 946 participants (384 female and 562 male) chosen at random in Rwanda. Four juices types were tested: two popular brands of 100% pineapple juice, one 100%-OFSP juice, and one 80% OFSP-20% pineapple juice blend. Consumers ranked different attributes of each juice such as aroma, taste, color, “right” amount of sugar, and aftertaste using a Likert scale (1 to 5). Heckman two-stage probit model was used to analyze willingness to pay and a multinomial logit model was used to analyze the determinants of juice choice. Gender of the consumer, juice buying frequency, aroma, the taste of the juice, and vitamin A knowledge were positively associated with willingness to pay and juice choice. Without nutritional information on OFSP juice, the willingness to pay for the standard juices were statistically higher; but with nutritional information, the willingness to pay and choice of OFSP juice was significantly improved. It is concluded that nutrition information is an important factor influencing the acceptance and willingness to pay for OFSP juice.

Keywords: Biofortification, nutritional knowledge, willingness to pay, consumer preferences, OFSP-Juice

Abbreviations

OFSP: Orange fleshed sweet potato;

WTP: Willingness to pay

1 Introduction

Micronutrient malnutrition, the lack of vitamin A, is one of the major public health problems in Africa. Globally, an estimated 250 million pre-school children are vitamin A deficient, of which about 10% become blind every year and half of these die within 12 months of losing their sight (Christian et al. 2006; Magadi 2011b). Malnutrition is the largest single factor contributing to childhood disease and is responsible for 30% of infant deaths (Headey 2013). Malnutrition also affects children’s physical development, school performance, mental capacity, labour productivity in old age, and, hence, the economic growth of countries (Apodaca 2008; Khonje et al. 2015; De Groote and Kimenju 2008; Low et al. 2007; Magadi 2011a; Meenakshi et al. 2012; Sindi et al. 2013). The joint United Nations Children’s Fund (UNICEF), World Health Organization (WHO), and World Bank Group report indicated that in 2012 alone, 36% of the world’s stunted children, 29% of underweight, and 28% of wasted children lived in Africa (Thompson et al. 2013). Similarly, in 2014, while the stunting rates dropped globally, more than one-third of all stunted pre five year old children lived in Africa, and the number continues to rise (UNICEF; WHO; and WB, 2015). The major cause of micronutrient malnutrition in Africa is the poor quality of diets (Bouis et al. 2011), the principally combination of poor availability and utilization of suitably nutritious food.

Orange fleshed Sweet potato (OFSP), which is

*Corresponding author: Temesgen Bocher, International Potato Center (CIP) Nampula Mozambique; E-mail: t.bocher@cgiar.org

Tawanda Muzhingi, Jan Low, International Potato Center (CIP), International Livestock Research Institute (ILRI), Old Naivasha Road, 25171-00603, Nairobi, Kenya

Kirimi Sindi, Jean Claude Nshimiyimana, International Potato Center (CIP), Kigali, Rwanda, Madjaliwa Nzamwita - Rwanda Agriculture Board, P.O. Box, 138, Huye, Rwanda

naturally high in beta-carotene, a precursor of Vitamin A, is a proven alternative to address vitamin A deficiency in children below two years of age and in pregnant women (De Groote and Kimenju 2008; Low *et al.* 2007). The beta-carotene contained in OFSP is easily absorbed by the body, and OFSP is both easy to grow and affordable to resource-poor households in developing countries (Chowdhury *et al.* 2011; Low *et al.* 2007). Improving the micronutrient content of crops, through breeding, has emerged as an alternative approach to artificial supplementation to combat micronutrient deficiencies, but addressing malnutrition through food-based approaches has received less attention from government and the scientific community than has supplementation.

Despite Rwanda's promising economic growth in the past few years and progress in key nutritional indicators since 2010, poverty rate and malnutrition remain high with nearly half the population living below the poverty line. The objective of the present study was to investigate consumer preferences and willingness to pay for juice made from nutritious OFSP in different markets in Rwanda; and the impact of nutritional information on product preferences, including purchase priorities.

2 Willingness to pay to products derived from biofortified crops

Studies have demonstrated an acceptance to pay for food made from biofortified crops. Systematic review of literature by Talsma, Melse-Boonstra, and Brouwer (2017) concluded that beta-carotene-rich sweetpotato "OFSP" prepared traditionally by boiling is well accepted by consumers in low income countries. In South Africa, OFSP chips, doughnuts, juice, and leaves were liked by both adults and children (Laurie and Heerden 2012). In rural Mozambique, bread buns made by replacing 38% of wheat flour with OFSP puree (boiled and mashed) were preferred over white flour bread buns (Jan W. Low and Paul J. van Jaarsveld 2008). Bett *et al.* (2013) used the contingent valuation method to identify factors influencing preferences and a two-stage Heckman selection model to determine decisions concerning choice and willing to pay for underutilized indigenous chicken products in Kenya. The latter study concluded that both individual characteristics and product attributes, such as educational status, age and income level of the consumer; price of the products and alternatives; taste, flavour, leanness, packaging, and, geographic location, all play decisive roles in determining WTP and preferences (Wang and Huo 2016; Bett *et al.* 2013; Halkos and Matsiori 2012;

Owusu-Sekyere *et al.* 2014). The main objective of this study was to determine whether prototype OFSP-based juices are acceptable to consumers in Rwanda.

A study by Meenakshi *et al.* (2012) had used a discrete random parameter logit model in a study of preference and WTP for biofortified orange maize against yellow and white maize varieties in Zambia and De Groote and Kimenju (2008) similarly studied preferences and WTP for biofortified yellow maize in urban Kenya using a semi-double-bound logistic model. However, there are few studies conducted on the willingness to pay for juice made from biofortified crops, such as sweetpotato. This study investigates the determinants and of willingness to pay for OFSP juice compared to pineapple juice. The study also identifies factors affecting WTP and preferences for OFSP-based juice and the differences in the WTP and preferences for other juice types compared to the two OFSP-based juices. The findings also address how having nutritional information affects both consumers' preference for juice and WTP for different juice types.

3 Methodology and data collection

3.1 Study design

This study is based on the survey of 946 individuals selected from seven different representative markets in Rwanda: five from Kigali city, one from Muzanze, and one from Muhanga town (Table 1). The survey locations were chosen to capture different urban socio-economic classes within Rwanda. About 80% of the individuals surveyed were selected from low-end market locations, 15% from middle-end markets and the remaining 5% from high-end markets (see Table 1). Respondents were asked to identify their most preferred juice among the four juice types (100%-OFSP, 80% OFSP/20% pineapple (P-SINA), pineapple juices *viz.*, Inyange (P-Inyange) and SINA brand (P-SINA).

Each of the survey enumerators wore a distinctive T-shirt identifying them as members of this study. Enumerators conducted surveys at the entrances of the identified shops or markets, seated at a comfortable table with two chairs: one for the enumerator and another for the respondent. Respondents were randomly selected from individuals visiting each market location. At the survey table, we placed four juices to be tested in identical clear plastic bottles: two bottles contained popular brands of pineapple juice, and the other two bottles contained OFSP-based juice products. Each of the bottles was marked with an identifying symbol for surveyors

Table 1. Distribution of respondents by the type of location and market type

Market location	Market type	# of respondents	Total by type	% total
UTC Store	High end	37	37	4%
SINA Nyirangarama Store	Middle end	34		
SINA Kigali Store	Middle end	108	142	15%
Musanze	Low end	101		
Kimironko	Low end	479		
Muhanga	Low end	119		
Gakenke	Low end	68	767	81%

UTC: Union Trade Centre (mall); SINA Nyirangarama: Urwibutso Enterprises's shop located in Nyirangarama; SINA Kigali: Urwibutso Enterprise shop located in Kigali

use. Since there has never been another marketed type of sweet potato-pineapple blend or 100%-OFSP juice, the selected juices were the best products for comparison tests. To reduce cross-contamination of flavours, we also had a bottle of water and small cups for respondents to rinse their mouths between each tasting.

At the beginning of the survey, each enumerator collected details about the respondents' socio-economic characteristics, juice buying habits, and the cost of the juices they usually purchased. Respondents indicated their preferences and buying frequencies and any other attributes that influenced their decision to buy juice. Respondents were unaware of the identity of the juice brands in the bottles to eliminate any bias that might otherwise occur due to respondents' pre-conceived attitudes. The respondents tasted each juice and ranked its attributes. The survey used a modified quadruple 'blind testing' methodology. Respondents ranked attributes such as colour, taste, after-taste, aroma, and sweetness on a 5-point Likert scale (1= dislike very much, 2= dislike slightly, 3= neither dislike nor like, 4= like slightly, and 5= like very much). Each question set was asked only after respondents had tasted a product which they did only once.

After indicating scores for the juices, respondents were asked to suggest the prices they were willing to pay for each of the products. Then respondents were given additional information that two of the juices were made using orange-fleshed sweet potato (OFSP), which is rich in beta-carotene, a precursor of vitamin A. After receiving this information, respondents were asked to re-evaluate these two products to determine if their preference for OFSP-based juices was affected by nutritional content. This approach was used to gauge if nutritional information would affect the respondents' attitude towards purchasing the products.

3.2 Econometric model

A consumer derives different utilities by choosing different juice varieties. Suppose that the consumer's utility derived from the consumption of juice (OFSP juices vs. pineapple juices), as stated in Loureiro et al. (2001) the utility can be represented as follows:

$$U_{ij} = X_i \beta_j + \varepsilon_{ij} \quad i=1, \dots, n; j=1, \dots, J \quad (1)$$

Where U_{ij} represents the utility derived by the i^{th} consumer from choosing the j^{th} juice type; X_i represents a set of variables that affects the decision to choose; β_j is the set of coefficients associated with each of the variables, X_i ; and ε_{ij} is the error terms.

Assuming rational consumer behavior, one can expect the consumer to choose the juice variety with the highest possible utility. If consumer i chooses juice type j , then utility U_{ij} is the highest utility that can be obtained among the four juice types. Thus, the probability that juice type j is chosen by individual consumer i is given by:

$$\begin{aligned} \text{Prob}(y_i = j) &= \text{Prob}(U_{ij} > U_{ia}; a = 1, 2, \dots, J, a \neq j) \\ &= \text{Prob}(\varepsilon_{ij} - \varepsilon_{ia} > \hat{U}_{ia} - \hat{U}_{ij}; a = 1, 2, \dots, J, a \neq j) \end{aligned} \quad (2)$$

Where $\hat{U}_{ij} = X_i \beta_j$ as stated by Maddala (1999), because the residuals, ε_{ij} and ε_{ia} , are independently and identically distributed error terms, the difference in error terms in equation (2), has a logistic distribution (Maddala 1999). Then the multinomial logistic model representing the probability of i^{th} consumer to select j^{th} juice type can be presented as:

$$\text{Prob}(y_i = j) = \frac{e^{X_i \beta_j}}{\sum_{k=1}^4 e^{X_i \beta_k}}, \quad j = 1, 2, 3, 4 \quad (3)$$

Where β_j is an estimated parameter that weights exogenous variables in determining the utility of j^{th} juice choice, X_i

is a row vector of exogenous variables representing the individual consumer characteristics and juice attributes. Survey data is analyzed using STATA, Statistics/Data Analysis version 14.1.

Ethical approval: The conducted research is not related to either human or animal use.

4 Results and discussion

4.1 Characteristics of survey participants

While the main emphasis of this study focused on juice preferences and WTP, it is believed that other individual characteristics possibly influence these two variables. For this reason, data about demographics, marketing, socio-economic status and prior knowledge about the benefits of vitamin A were collected in addition to respondents' juice preferences and buying frequencies. Most respondents were male (59%), while the average age of respondents was about 29 years, with minimum and maximum age being six and 89 years respectively. About three-quarters of the respondents had heard of vitamin A. An overwhelming majority of respondents bought juice weekly. Affordability of juice, tastiness, and perceived health benefits of the juice were the major factors attributed to juice-buying preferences. More than three-quarters of respondents resided in lower income areas, while less than 5% lived in higher income areas (Table 2).

4.2 Willingness to pay

About one-third of the respondents preferred P-SINA juice and were willing to pay on average 465 RWF (USD 0.67) for a half liter (Table 3). This is likely due to this juice being a popular brand in the market and hence consumers were familiar with it. On the other hand, only 13% of the respondents preferred 100%-OFSP juice and it had a lower WTP for a half-liter. Nearly, one-third of the respondents indicated they preferred the OFSP juice blend and the respondents' WTP indicated no sizeable difference between the OFSP blend and the two pineapple juices. This confirms that there is no difference in consumer preference and WTP between pineapple juice and juice blended with OFSP.

Both the consumers' gender and prior knowledge about vitamin A influenced the WTP for OFSP-based juices. The results show that male consumers had a higher WTP for 100%-OFSP juice; however, there seems to be no significant difference between male and female consumers in terms of WTP for blended juice. There was a statistically significant difference in WTP for OFSP-based juices between consumers who had prior knowledge about vitamin A, and those who did not. Those consumers who had heard of vitamin A, were willing to pay a higher price for OFSP-based juices (Table 4).

To empirically measure the consumers' WTP for juices and identify factors influencing it, a two-stage Heckman probit model was estimated for the four juice types (Table 5). It has been hypothesized that consumer's WTP and product preference is influenced by consumers' demographic characteristics. Thus factors such as age,

Table 2. Characteristics of the survey participants (n=947)

Variable	Mean/proportion	Std. Dev.	Min	Max
Sex (=1, if sex is male)	0.59	0.49	0.00	1.00
Age (year)	28.95	9.40	6.00	89.00
Hear of vitamin A (=1, if yes)	0.76	0.43	0.00	1.00
Quantity bought (liters/week)	2.99	0.98	0.25	32.00
Natural log of price (RWF)	6.76	1.04	4.61	11.00
Buy juice weekly (=1, if yes)	0.79	0.41	0.00	1.00
Bought because it is affordable (=1, if yes)	0.32	0.47	0.00	1.00
Bought because it is tasty (=1, if yes)	0.25	0.43	0.00	1.00
Bought because it is healthy (=1, if yes)	0.29	0.45	0.00	1.00
Lower market dummy (=1, if yes)	0.81		0.00	1.00
Middle market dummy (=1, if yes)	0.15		0.00	1.00
Upper market dummy (=1, if yes)	0.04		0.00	1.00

RWF: Rwandese francs, 1USD~ 700RWF during the survey period

Table 3. Willingness-to-pay and most preferred juice type (n=946)

Juice type	Best juice N (%)	WTP (RWF(\$))	Standard Deviation	Maximum
P-Inyange	230(24.29)	453(\$0.65)	146(\$0.21)	1,500(\$2.14)
P-SINA	321(33.90)	465(\$0.66)	281(\$0.40)	8,000(\$11.43)
OFSP juice (100%)	120(12.67)	396(\$0.57)	182(\$0.26)	3,000(\$4.29)
Blend ¹	275(29.04)	451(\$0.64)	360(\$0.51)	7,000(\$10.00)
All		441(\$0.63)	156(\$0.22)	2,350(\$3.36)

1USD~ 700RWF; RWF Rwandese franc; P-Inyange: Pineapple-Inyange; P-SINA: Pineapple-SINA

¹Blend juice is made of 80% OFSP and 20% SINA pineapple juice; OFSP: Orange-fleshed sweetpotato

Table 4. Participants' opinion towards different juice attributes (# of respondents)

Juice type	Sex of participant		Heard of vitamin A			
	Female (384)	Male (562)	Difference	No (228)	Yes (718)	Difference
100%-OFSP	376 (8.38)	461 (8.11)	-35**(12.01)	373 (10.06)	404 (7.09)	-31**(13.81)
Blend	433 (19.25)	464 (14.68)	-31 (23.84)	408 (12.68)	465 (14.86)	-58**(27.33)

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5. Natural logarithm of willingness-to-pay Heckman two-stage probit model

Variables (Dept. LnWTP)	100%-OFSP	Blend (20/80)	P-Inyange	P-SINA
Sex (1= male, 0 otherwise)	0.10*** (0.02)	0.07** (0.03)	0.01 (0.02)	0.04 (0.07)
Age (in years)	-0.00* (0.00)	-0.00 (0.00)	-0.00*** (0.00)	-0.01 (0.00)
Quantity bought(liters/month)	0.05 (0.03)	0.03 (0.03)	-0.01 (0.03)	0.03 (0.08)
Dummy heard of vitamin A (1 Yes, 0 No)	-0.01 (0.00)	-0.00 (0.01)	-0.00 (0.00)	0.00 (0.01)
Natural log price (\$)	-0.02 (0.01)	-0.03** (0.01)	-0.04** (0.01)	-0.02 (0.04)
Dummy right amount of sugar (1 Yes, 0 No)	0.08* (0.04)	0.09** (0.03)	0.09*** (0.02)	0.09 (0.08)
Dummy like aroma (1 if like)	0.08* (0.03)	0.04 (0.03)	0.04 (0.03)	0.03 (0.09)
Dummy like taste (1 if like)	0.20*** (0.03)	0.26*** (0.05)	0.07* (0.03)	0.08 (0.09)
Taste consistent (1 if consistent)	0.04 (0.02)	0.07* (0.03)	0.03 (0.02)	-0.00 (0.08)
Dummy like color (1 if like)	0.03 (0.03)	0.03 (0.03)	0.05* (0.02)	-0.01 (0.07)
Dummy buy weekly (1 if buys weekly)	0.15*** (0.03)	0.14*** (0.04)	0.08* (0.03)	0.08 (0.11)
Dummy affordable (1 if Yes)	-0.00 (0.04)	-0.00 (0.05)	0.09* (0.04)	0.09 (0.13)
Dummy tasty (1 if Yes)	0.04 (0.04)	0.00 (0.05)	0.06 (0.04)	0.07 (0.12)
Dummy Healthy (1 if Yes)	0.03 (0.04)	0.01 (0.05)	0.08* (0.04)	0.08 (0.12)
2.Middle market dummy	0.07* (0.03)	0.09* (0.04)	0.04 (0.03)	0.05 (0.10)

Variables (Dept. LnWTP)	100%-OFSP	Blend (20/80)	P-Inyange	P-SINA
3.High market dummy	0.07 (0.06)	0.10 (0.07)	0.12* (0.06)	0.12 (0.18)
Probit selection equation willing to pay (1 if Yes)				
Age (in years)	-0.02** (0.01)	-0.02* (0.01)	0.03 (0.06)	0.00 (0.02)
Quantity bought (liters/month)	0.30 (0.19)	0.52* (0.21)	-4.29 (6415.78)	0.12 (0.35)
Natural log price (RWF)	0.04 (0.06)	0.08 (0.08)	0.50 (0.61)	0.00 (0.06)
Dummy like aroma (1 if like)	0.06 (0.09)	0.02 (0.11)	-0.63 (0.47)	0.46 (0.32)
Dummy like taste (1 if like)	0.84** (0.29)	0.29 (0.30)	-4.80 (2712.78)	-0.11 (0.38)
Taste consistent (1 if consistent)	0.59* (0.24)	5.69 (10.02)	-4.92 (2315.81)	0.35 (0.38)
Dummy like color (1 if like)	0.17 (0.19)	0.24 (0.21)	-5.48 (2032.44)	0.65 (0.45)
Dummy buy weekly (1 if buys weekly)	0.08 (0.19)	0.00 (0.20)	0.38 (0.74)	0.21 (0.35)
Dummy affordable (1 if Yes)	-0.29 (0.28)	-0.08 (0.29)	-6.13 (3222.90)	-5.20* (2.03)
N	944	944	944	944
Sigma	0.34	0.39	0.34	1.06
Lambda	0.09	-0.27	0.03	-1.06

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

sex, family size, education, purchasing frequency, perception about the product, nutritional knowledge, and income level have an influence; (Ariyawardana et al. 2009; De Groote et al. 2014; Haghighi et al. 2013; Olynk and Ortega 2013; Wang and Huo 2016; Zhang et al. 2012), as do product attributes such as taste, colour, aroma, price, and mouthfeel (Chowdhury et al. 2011). Table 5 presents the estimated coefficients for the probit model for the first stage and the OLS results for the second stage. In this study, the sex factor coefficient was statistically significant for 100%-OFSP and blended juice. Consistent with the descriptive analysis from Table 4, there was a significant difference between male and female consumers regarding WTP for the OFSP-based juice. Compared with female consumers, male consumers were willing-to-pay 10% and 7% more for 100%-OFSP and blended juices, respectively.

Consumers' age negatively influences WTP for juices; this is noteworthy for both the 100%-OFSP and P-Inyange juices. Older respondents were less likely to pay for any of the juices compared with the younger respondents. This was particularly significant for 100%-OFSP and the P-SINA juices. For the blend and P-Inyange juices, juice price has significant negative influence on WTP. The perceived "right" amount of sugar positively affects the

WTP, and consumers who reacted positively to a juice's sugar content were willing to pay about 10% more, except for P-SINA juice. Note that the P-SINA juice had the highest sugar content of all the juices while the 100% OFSP juice, with no artificial sugar had lowest sugar content. Juice taste substantially affected WTP; with the coefficient on market dummy indicating that, compared with the lower market segment, middle-income consumers were willing to pay a significantly higher premium for 100% OFSP and blended juice. This was attributed to the fact that the middle-income consumers were more concerned about the nutritional content of the foods. Probit selection model presents the second stage decision to pay for juices. Factors, such as taste, and mouthfeel affected WTP for OFSP based juices.

4.3 Determinants of juice preferences

While P-SINA was preferred in terms of sugar content, aroma, and taste, preference for the OFSP-pineapple blend juice was similar to pineapple juices (Table 6). The vast majority (90%) of the consumers disliked the sugar content of 100%-OFSP juice. Similarly, more than three-

Table 6. Preference, attributes and perception towards juice

Attributes	100%-OFSP	OFSP Blend	P-Inyange	P-SINA
Right amount of sugar (=1, if yes)	0.10	0.23	0.25	0.41
Like aroma (=1, if yes)	0.38	0.44	0.72	0.77
Like taste (=1, if yes)	0.42	0.58	0.66	0.76
Like color (=1, if yes)	0.33	0.71	0.47	0.40
Aftertaste (=1, if yes)	0.50	0.64	0.49	0.59
Willing to pay (=1, if yes)	0.96	0.96	0.99	0.99

quarters of the respondents mentioned that they liked the aroma of the P-SINA juice followed by the P-Inyange juice. The taste of P-SINA juice was preferred by about 75% of the respondents followed by P-Inyange juice (66%). Forty percent of respondents preferred the P-SINA juice for its yellow colour while a great majority liked the orange colour of the blended juice. The mouthfeel of P-SINA juice was preferred by a considerable proportion of the respondents.

Preference is influenced by juice-related attributes such as taste, colour, aroma, mouthfeel, aftertaste, and price and consumer characteristics such as age, sex, number bought, buying frequency, and product knowledge (Chowdhury et al. 2011; De Groote et al. 2014; Olynk and Ortega 2013; Wang and Huo 2016; Zhang et al. 2012). The preference to the OFSP-based juices was affected significantly by the demographic characteristics of consumers (Table 7). The marginal coefficient of the sex of the consumer was positively significant for 100%-OFSP juice ($p < 10\%$), and negatively significant for the blend ($p < 1\%$), indicating male consumers preferred 100%-OFSP juice, while female consumers preferred the OFSP blended juice. For the 100%-OFSP juice, the right amount of sugar ($p < 1\%$), aroma of the juice ($p < 5\%$), and dummy-like taste ($p < 1\%$), had a positive and significant effect on its preference; the dummy that the juice is tasty negatively influences choice. Compared to the low-end market, consumers in the high-end market appreciate the blended juice more than other juices. The insignificance of the coefficients on the vitamin A knowledge could be explained by the quality of the information sources about the health importance of vitamin A and needs further investigation of the causes.

4.4 The impact of nutritional information

Table 8 presents ranking on Likert scale for different juice attributes and WTP for four juices. The descriptive analysis showed that without nutritional information on the label, significantly larger numbers of consumers

ranked “the OFSP-based juice” highly for colour. But the OFSP-based juices received a lower rank overall for attributes such as aroma, taste, aftertaste, and mouthfeel. The pineapple juices only received an average rank and the WTP is highest for the P-SINA juice, followed by the P-Inyange juice. In all cases, the pineapple juice received a higher ranking and WTP for a half liter of juice.

To investigate the effect of nutritional information on consumer preferences and WTP, respondents re-evaluated the juices after they were provided nutritional information (Table 8). When consumers were provided with the nutritional information that OFSP juices have the highest pro-vitamin A contents, consumers’ preferred the OFSP-based juices and the WTP increased. In addition, a preference for colour, aroma, taste, aftertaste, and mouthfeel of 100%-OFSP juice improved (Table 9). However, aroma, taste, and mouthfeel of the blended juice still received the lowest score even after the introduction of the nutrition information. This finding was consistent with studies by Kinnucan et al. (1997), who found significant positive impacts of health information on meat demand and Chowdhury et al. (2011), who found nutritional information was translated into increased WTP for orange fleshed sweet potato varieties in Uganda. This indicates the importance of nutritional information during marketing campaigns in order to boost the dissemination and acceptance of biofortified sweetpotato products among consumers.

5 Conclusion

The study concluded that both WTP and consumer preferences are influenced by juice attributes and consumer characteristics. Even though many consumers disliked 100%-OFSP juice for aroma, taste, and mouthfeel; there was no difference in preference between the 80% OFSP-20% Pineapple and the 100% pineapple juices. However, WTP for OFSP-based juices varied based on demography and economic class: while younger consumers and females were reluctant to buy OFSP-based

Table 7. Juice choice Multinomial logit model (marginal effect coefficients)

Variables (Best juice)	100%-OFSP	Blended	P-Inyange	P-SINA
Sex (1= male 0 otherwise)	0.04* (0.02)	-0.11*** (0.03)	0.03 (0.03)	0.04 (0.03)
Age (in years)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
LnPrice	0.01 (0.01)	-0.02 (0.01)	0.00 (0.02)	0.01 (0.02)
Dummy right sugar (1 Yes, 0 No)	0.18*** (0.02)	-0.09 (0.07)	-0.09 (0.07)	-0.01 (0.06)
Dummy like aroma (1 Yes, 0 No)	0.06** (0.02)	-0.00 (0.03)	-0.02 (0.03)	-0.03 (0.03)
Dummy like taste (1 Yes, 0 No)	0.09*** (0.02)	-0.01 (0.03)	-0.11*** (0.03)	0.03 (0.03)
Taste consistent (1 Yes, 0 No)	0.01 (0.02)	-0.02 (0.03)	-0.08* (0.03)	0.09** (0.03)
Dummy like color (1 Yes, 0 No)	0.01 (0.02)	-0.06* (0.03)	-0.02 (0.03)	0.07 (0.03)
Dummy buy weekly (1 Yes, 0 No))	0.04 (0.03)	-0.07 (0.04)	0.01 (0.05)	0.01 (0.04)
Dummy affordable (1 Yes, 0 No)	-0.02 (0.03)	0.01 (0.05)	0.13* (0.06)	-0.12* (0.05)
Dummy tasty (1 Yes, 0 No)	-0.08* (0.03)	-0.01 (0.05)	0.07 (0.06)	0.02 (0.05)
Dummy healthy (1 Yes, 0 No)	-0.07* (0.03)	-0.04 (0.05)	0.08 (0.06)	0.03 (0.05)
Number bought (package/bottle)	-0.00 (0.00)	0.01 (0.01)	0.00 (0.01)	-0.00 (0.01)
Dummy heard vitamin A (1 if Yes)	-0.01 (0.02)	-0.02 (0.03)	0.03 (0.04)	-0.00 (0.03)
2.Medium market dummy	-0.03 (0.03)	-0.05 (0.04)	0.01 (0.04)	0.07 (0.04)
3.High market dummy	-0.06 (0.04)	0.19* (0.09)	0.05 (0.08)	-0.18** (0.05)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, P-Inyange juice is used as reference for multinomial logit model, lower market is used as a base, the Blend juice is used as a base in multinomial logit model.

Table 8. Average Likert Scores (range 1-5) for juice attributes and WTP, without nutrition information (n=944)

Juice type	Color	Aroma	Taste	Aftertaste	Mouthfeel	WTP
P-Inyange	3.18	3.86	3.65	3.48	3.21	453
P-SINA	3.08	3.99	4.00	3.8	3.62	466
OFSP-Juice	3.96	2.88	2.98	2.97	3.22	397
Blend	3.82	3.1	3.48	3.36	3.59	451
T-statistics difference in means without nutritional information of the juice						
OFSP vs. P-Inyange	0.78***(0.07)	-0.98***(0.06)	-0.67***(0.06)	-0.51***(0.07)	0.01(0.07)	-56*** (6.20)
OFSP vs. P-SINA	0.88***(0.06)	-1.11***(0.06)	-1.02***(0.06)	-0.83***(0.06)	-0.4***(0.06)	-69*** (10.55)
OFSP vs. P-Blend	0.13***(0.04)	-0.22***(0.05)	-0.05***(0.06)	-0.39***(0.05)	-0.37***(0.05)	-54** (11.83)
Blend vs. P-Inyange	0.65***(0.07)	-0.76***(0.07)	-0.17** (0.07)	-0.12(0.07)	0.38*** (0.07)	-2 (11.82)
Blend vs. P-SINA	0.75***(0.06)	-0.89***(0.06)	-0.52*** (0.06)	-0.44*** (0.07)	-0.03(0.07)	-14 (13.76)

Table 9. Average Likert Scores (range 1-5) for juice attributes and WTP, with nutrition information (n=129)

Juice type	Color	Aroma	Taste	Aftertaste	Mouthfeel	WTP
P-Inyange	2.78	3.55	3.40	3.24	2.93	417
P-SINA	3.05	3.80	3.68	3.60	3.44	406
OFSP-Juice	4.16	3.87	4.02	3.89	4.00	449
Blend	3.88	3.43	3.24	3.47	3.75	399
T-statistics difference in means after nutritional information of the juice is provided						
OFSP vs. P-Inyange	1.37*** (0.19)	0.32* (0.18)	0.62*** (0.17)	0.65*** (0.19)	1.07*** (0.18)	33** (16)
OFSP vs. P-SINA	1.11*** (0.11)	0.07 (0.17)	0.33** (0.17)	0.29 (0.18)	0.55*** (0.17)	43** (17)
OFSP vs. P-Blend	0.27** (0.12)	0.44*** (0.16)	0.78*** (0.18)	0.43** (0.17)	0.24 (0.17)	50*** (18)
Blend vs. P-Inyange	1.10*** (0.20)	-0.12 (0.21)	-0.16** (0.19)	0.22 (0.21)	0.82*** (0.20)	-18 (18)
Blend vs. P-SINA	0.83*** (0.17)	-0.37** (0.17)	-0.44*** (0.18)	-0.13 (0.19)	0.31* (0.18)	-8 (16)

Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. *100% Pineapple juices: P-Inyange and P-SINA. OFSP-Juice is 100%-OFSP; Blend is 80% OFSP, 20% Pineapple juice.

juice, males and middle-income consumers were willing to pay higher prices for it. Similar results were reported in the studies by Chowdhury et al. (2011); De Groote et al. (2014) and Zhang et al. (2012). Moreover, high end market consumers were less likely to consume the traditional SINA-pineapple juice; creating additional evidence for a shift in consumer preference towards healthier OFSP products with increased income. Prior knowledge about the importance of vitamin A has a significantly positive impact on WTP and juice preference. Those consumers who had no previous knowledge about vitamin A expressed lower interest in purchasing OFSP-based juices. Individuals who had heard about vitamin A demonstrated increased WTP.

This is an encouraging message to further increase the supply of processed OFSP products in the Rwandese markets, beneficial for local sweet potato farmers and contributing to eradication of malnutrition through increased consumption of biofortified nutritious foods. Creating an educational campaign on the importance of vitamin A for maintaining a healthy lifestyle is another way to successfully market OFSP juice. This sensory study indicated that WTP as well as preference for OFSP-based juice depends primarily on whether nutritional information is provided or not. Our results suggest that the inclusion of nutritional information on the juice label or in advertisements is a key tool for improving the WTP and preference for OFSP-based juice. Without nutritional information, consumers were inclined to prefer other juice types, and their WTP is significantly lower for OFSP-based juices. Programs and activities interested in the

dissemination of OFSP varieties, consumption of OFSP roots and processed products, and marketing should incorporate nutritional education to achieve a reduction in vitamin A deficiency, thus linking improved agricultural productivity and population health.

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