



Research report

Influence of sensory and cultural perceptions of white rice, brown rice and beans by Costa Rican adults in their dietary choices [☆]



Rafael Monge-Rojas ^{a,*}, Josiemer Mattei ^b, Tamara Fuster ^c, Walter Willett ^b, Hannia Campos ^b

^a Nutrition and Health Unit, Costa Rican Institute for Research and Education on Nutrition and Health (INCIENSA), Ministry of Health, Tres Ríos, Costa Rica

^b Department of Nutrition, Harvard School of Public Health, Boston, MA, USA

^c Department of Psychology, Universidad Nacional, Heredia, Costa Rica

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ABSTRACT

Little is known about the distinct perceptions towards rice and beans that may shape the consumption of these main staple foods among Costa Ricans. We aimed to identify barriers and motivators that could change the current staple into a healthier one, and assess the sensory perceptions of these foods in this population. Focus group discussions and sensory tastings of 8 traditional white or brown rice and beans preparations were conducted in 98 Costa Ricans, aged 40–65 years. Traditional habits and family support emerged as the two main drivers for current consumption. Consuming similar amounts of rice and beans, as well as unfamiliarity with brown rice, are habits engrained in the Costa Rican culture, and are reinforced in the family and community environment. Suggested strategies for consuming more brown rice and more beans included introducing them during childhood, disseminating information of their health benefits that take into account the importance of tradition, lowering the cost, increasing availability, engaging women as agents of change and for brown rice masking the perceived unpleasant sensory characteristics by incorporating them into mixed dishes. Plain brown rice received the lowest mean hedonic liking scores. The preparations rated highest for pleasant were the beans: rice 1:1 ratio regardless of the type of rice. This study identified novel strategies to motivate Costa Rican adults to adapt their food choices into healthier ones within their cultural and sensory acceptability.

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Introduction

Rice is a main staple food in many countries, with Asia, Latin America and the Caribbean comprising the top producers and consumers of such commodity (Kennedy, Burlingame, & Nguyen, 2002). White rice is the primary type consumed, whereas hulled or brown rice is rarely consumed. This is partly due to manufacturing practices, as over 65% of the global paddy rice undergoes extensive industrial processing, including milling and polishing, to convert it into polished white rice (Kennedy et al., 2002). Thus, the bulk of

the rice available for consumption as white rice is depleted of the essential vitamins, minerals, protein, and fiber contained in the outer layers of the grain, which are removed during the industrial process (Calpe, 2006). The level of processing increases the glycemic index of white rice, i.e. its ability to raise postprandial blood glucose levels (Foster-Powell, Holt, & Brand-Miller, 2002).

Throughout generations, people in many Latin American and Caribbean countries have traditionally eaten white rice with legumes (Barbosa, 2012; Houston, 2005; Janer, 2008; Noel, Newby, Ordoñez, & Tucker, 2009; Rodrigues, da Costa Proença, Calvo, & Fiates, 2013), a combination that restores adequate protein and fiber intake. However, the global demand for white rice has been rising while consumption of legumes has decreased since the 1960s. In Latin America and the Caribbean, the contribution of milled white rice to energy increased by 28% from 12–30%, while the intake of legumes has remained stagnant between 3 and 4% (Akibode & Maredia, 2011; Kennedy et al., 2002). The particular situation of Costa Rica epitomizes the global trends. White rice and beans (predominantly black beans) comprise the base of many meals in Costa Rica usually supplemented with another side dish (Janer, 2008). According to FAO data, Costa Rica was classified as a “high rice consumer” in 1999 (Nguyen,

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* Corresponding author.

E-mail address: rmonge@inciensa.sa.cr (R. Monge-Rojas).

2002). The per capita rice supply was 170 g/person/day, equivalent to a contribution of 640 kcal/person/day, and representing an exponential growth rate of 12% in just 4 years. On the other hand, a 46% reduction in bean consumption has been reported in Costa Rica in a period of 30 years (Rodríguez-Castillo & Fernández-Rojas, 2003).

The opposing trends in consumption of white rice and legumes raise concern in light of the steep increase in the global prevalence of diabetes and related chronic disease (Hu, 2011; Noel et al., 2009). Recent epidemiological studies show that higher intake of white rice is associated with increased risk of type 2 diabetes (Hu, Pan, Malik, & Sun, 2012; Nanri et al., 2010; Sun et al., 2010; Villegas et al., 2007), while substituting it for brown rice is associated with lower risk (Sun et al., 2010). On the other hand, increased intake of legumes has been associated with prevention of type 2 diabetes, heart disease, obesity, high blood pressure, and cancer (Bouchenak & Lamri-Senhadji, 2013; Curran, 2012). One of our studies in a Costa Rican adult population showed that intake of a higher ratio of beans to white rice, or replacement of one serving of white rice for one serving of beans, was associated with lower prevalence of components of the metabolic syndrome (Mattei, Hu, & Campos, 2011). Together, these studies suggest that consuming brown instead of white rice and increasing the intake of legumes may improve the cardiometabolic profile and reduce the risk of diabetes. In order to create potential strategies to encourage such dietary changes, it is essential to understand the factors that may drive, and potentially sway, the behaviors, choices, and preferences related to intake of white rice, brown rice, and legumes.

Urbanization, higher income and education, and modern unhealthy lifestyles have been associated with lower legume and higher processed food consumption (Caballero, Allen, & Prentice, 2012; Kabagambe, Baylin, Ruiz-Narvarez, Siles, & Campos, 2005; Popkin, Adair, & Ng, 2012; Uauy & Monteiro, 2004), but little is known about the distinct perceptions and attitudes toward rice and legumes that could influence their consumption. A few recent qualitative studies across various cultural groups have suggested potential factors that may facilitate or hinder increased intake of brown rice or legumes. In India, tradition, differences in cooking and sensory qualities were considered the main reason for choosing white over brown rice (Kumar et al., 2011; Vasudevan et al., 2013). Sensory perceptions of brown rice (rough texture and unpalatable taste) were also rated mostly positive among Tanzanian obese adults (Muhithi et al., 2013), but not among Chinese adults (Zhang et al., 2010). Main barriers for consumption of brown rice among Indians were lack of awareness about its nutritive properties and perceived inferiority (Kumar et al., 2011), while for Chinese adults the barriers were inferior taste, quality, and price (Zhang et al., 2010). There are fewer studies for legumes consumption in Latin America, but a survey among Puerto Rican adults revealed taste and nutrition as the main reasons for consuming them (Mattei & Campos, 2014). Earlier studies are methodologically comparable, thereby indicating that culture pervasively underlies all food choices.

The previous studies collectively suggest that there are opportunities to improve the diet, and possibly health status, of each population using local staple foods. But the studies also highlight peculiarities across cultures, and any potential dietary intervention or program to promote healthy eating should consider these cultural intricacies in order to enhance its success. To date, there are no studies on the cultural and sensory perceptions of rice and beans in Costa Rica. Also, little is known about which factors may enable or prevent acceptance of brown rice as a substitute of white rice, or of an increased ratio of beans in the common combination. In response, the aim of this study is to identify barriers and motivators that could influence changes in current consumption of these staple foods to a healthier one, and assess the sensory perceptions of brown rice and beans in the traditional combinations

among Costa Rican adults, using focus group discussions and food sensory tastings.

Materials and methods

Study sample

The study was conducted from February to November, 2012 in two rural zones (San José de la Montaña and Llano de Grande) and two urban zones (Moravia and Desamparados) within the Great Metropolitan Area of Costa Rica, where the largest percentage of the Costa Rican population resides (Instituto Nacional de Estadística y Censos (Costa Rica), 2011). The study was advertised through flyers distributed by community leaders (i.e. church priests and ministers, development agencies, and teachers). Participants had to be aged 40–65 years and free of major non-communicable chronic diseases (i.e. hypertension, type 2 diabetes, cancer, or cardiovascular disease). The latter exclusion criterion was included to reduce some bias in the responses, as each person may perceive or define certain experiences based on their health status.

The Costa Rican Institute for Research and Education on Nutrition and Health (INCIENSA, Spanish acronym) and Harvard University Institutional Review Board for Human Research approved the study. All participants provided written consent and were given the opportunity to ask any questions about the study or the consumption of white or brown rice, and beans, which were all clarified. No monetary incentives or reimbursements were provided. All participants received a complimentary copy of the Dietary Guidelines for Costa Ricans at the end of the study.

Questions and implementation of the focus group discussions

On the day when the focus group was scheduled, prior to starting, height and weight were measured in duplicate in all participants to estimate BMI (kg/m²). Each participant was asked to complete a self-administered questionnaire on socio-demographic characteristics. The focus groups were homogeneous with respect to sex, BMI status (≤ 25 or > 25), and residential area (urban or rural); i.e.: men and women, low and high BMI, or rural and urban were not combined in a group. A total of 16 focus groups were conducted with six to eight participants each. Each focus group consisted of three sessions conducted sequentially on the same day. Two focus group sessions were held before performing the food sensory tastings, and the third focus group session was held after this.

Each session specifically discussed: (1) barriers and motivators for eating higher proportion of beans to white rice, based on its association with lower odds of cardiometabolic risk factors (Mattei et al., 2011), (2) barriers and motivators for eating brown rice instead of white rice, and based on its association with lower risk of diabetes (Sun et al., 2010), (3) perception of the sensory characteristics of food preparations that included white or brown rice with and without black beans at various ratios. The three sessions of each focus group, including the tastings, were carried out with the same participants throughout, with no attrition. Each focus group was audio-recorded, and was facilitated by a trained Spanish-speaking moderator, with assistance of a co-moderator.

Before starting the first focus group session, participants were shown samples of 7 food preparations with beans: rice ratios of 0.5:1, 1:1, 1:2, 1:0.5, 1:3, 2:1, 3:1. Subsequently, they were asked to write down the ratio that most closely resembled the one that they usually consumed and briefly describe the reason for their selection. This was followed by the first session using a guideline of questions developed by the research team to examine each topic in depth. Each session ended once data saturation was reached. Examples of the questions for the first two sessions include:

Session 1:

- Why do you prefer this proportion of rice to beans?
- Would you eat a higher ratio of beans to rice?
- If I were to tell you that to prevent type 2 diabetes and heart disease, it is best to eat a higher proportion of beans to rice, would you eat it? Why or why not?

Session 2:

- Which type of rice do you and your families frequently eat? Why?
- What do you think of brown rice?
- Why do you think people prefer to eat white rice rather than brown rice?
- If I were to tell you that several scientific studies show that eating brown rice is healthier than eating white rice, would you replace the white rice with brown rice? Why or why not?

Food sensory tastings

After the second session, participants were asked to start a food sensory tasting of 8 different dishes. The tasting foods were plain white rice, plain brown rice, and six beans: rice combinations of 1:3, 1:1, and 3:1, with either white or brown rice. The recipes were standardized to maintain consistency, and all foods were prepared on the same day the focus group was conducted. Recipes were prepared using the traditional stir-fried method, and white or brown rice and black beans cooked the day before. On the day of the study, garlic, onion and red pepper were sautéed in soybean oil and cooked black beans were added, and stirred up together. After that, cooked brown or white rice was added and stirred up all together again. Cilantro was added at the end and the mixture was stirred.

A portioning spoon equivalent to 1/4 of a cup (60 g) was used to serve the food to each participant. All preparations were served at $57^{\circ} \pm 2^{\circ} \text{C}$ to avoid alterations in texture, odor or taste. The order in which the foods were presented was balanced (Stone & Sidel, 2004), such that the recipes with the same ratio of beans: rice or those that were prepared with brown rice versus white rice were separated to avoid biasing the evaluation.

Tastings were conducted as previously described by Lawless and Heymann (2010). Briefly, sensory evaluations were carried out in 8 portable sensory-cubicles with the chair and school desk covered in white tablecloth. Each participant was provided with a hedonic scale to rate each preparation, a pen, water for drinking, and slices of green apple to consume between each tasting preparation as a palate cleanser. The hedonic scale included 9-points: extremely unpleasant (1), very unpleasant (2), moderately unpleasant (3), somewhat unpleasant (4), neither unpleasant nor pleasant (5), somewhat pleasant (6), moderately pleasant (7), very pleasant (8), extremely pleasant (9) to evaluate four sensory characteristics (i.e.: color, odor, taste, texture), and the overall appraisal of each food.

After the tasting, participants met again with the moderator for the third and last focus group session where they discussed the hedonic liking scores. Participants were guided using a pre-defined set of questions. The session ended once data saturation was reached. Examples of the questions for the third focus group session include:

Session 3:

- Now that you have tasted brown rice, do you think you could incorporate it as part of your daily meals? Why or why not?
- If you were trying to convince other people to eat brown rice, what would you tell them?

- Who do you think would incorporate brown rice in their dietary habits more easily?
- What suggestions would you give to make brown rice more appealing to people?

To avoid bias in the participants' responses, the researchers did not discuss the effect of white and brown rice or beans on health at any time. All questions that participants had about these issues were answered after the conclusion of the third focus group session.

Data analysis

The focus group tapes were transcribed verbatim. Data from each topic was summarized by area of residence and BMI category. Data analysis was conducted using an inductive approach whereby themes emerged from the data itself. Transcribed data from four focus group sessions were used to develop a draft-coding scheme containing key themes and sub-codes within these themes. The data for the development of this tool were coded manually by one of the study's authors (TF-B). The draft-coding scheme was then applied to additional transcriptions and modified as new themes arose. A final coding scheme, consisting of ten relevant codes, was developed upon consensus. Codes and sub-codes were defined in a coding dictionary. Data coding was conducted independently by three previously trained, independent coders, until an agreement percentage $\geq 90\%$ was achieved.

Transcripts were entered into the qualitative data analysis software Atlas.ti version 5.0 (Scientific Software Development, Berlin, Germany), and coded to categorize texts according to recurring themes, concepts, and terms. Quotations related to each code were isolated and sorted, generating lists to determine the most common responses. The quote that best described each relevant code was selected, in order to illustrate the response that participants had for a specific issue. Differences in coding were minimal, and consensus was easily achieved.

For the food sensory tasting data, categories from the hedonic scale were transformed to a numeric score from 1 to 9. Each individual hedonic rating of different sensory modalities measured as well as the overall appraisal of the food preparations were analyzed using intra-subject analysis of variance for repeated measures. A post-hoc Bonferroni correction test was used to determine significant differences ($P < 0.05$) in mean scores. The Mauchly test was conducted to confirm the validity of the sphericity assumption (Bagiella, Sloan, & Heitjan, 2000). The assumption was not met for overall appraisal of the hedonic scale, for color, and for texture; thus, we applied a Greenhouse–Geisser correction. Statistical analyses were performed using SPSS v15.0 (Chicago, Illinois).

A frequency distribution was performed to determine the frequency of pleasantness ratings for each food preparation included in the food sensory tasting. Preparations that scored in the range of 6–9 points according to the 9-point hedonic scale were defined as “pleasant”, while those that scored in the range of 1–5 points were defined as “not pleasant”.

Results*Participation and baseline characteristics*

A total of 325 people responded to the advertisement. Of those, 200 did not meet eligibility criteria (20% were outside of the age range, and 80% had some diagnosis of a non-communicable chronic disease as reflection of the epidemiological profile of Costa Rican in the 40–65 year age range). Of the 125 eligible individuals who were scheduled for a focus group, 98 actually participated. In total, 16 focus groups (with three sessions each one) were conducted, with six to eight participants per group. The general characteristics of

Table 1

Socio-demographic characteristics of Costa Rican adults participating in 16 focus groups and sensory tastings of white or brown rice and beans^a.

	Men n = 46	Women n = 52	P-value
Urban area (%)	48	52	0.325
Rural area (%)	49	51	0.254
Age (years)	46.1 ± 5.6	45.3 ± 6.3	0.690
BMI (kg/m ²)	28.2 ± 4.1	30.6 ± 6.1	0.034
Family income in \$US/month (%)			
<1000	23.3	44.7	0.038
1001–2000	40.3	26.4	0.012
>2001	36.7	28.9	0.046
Formal years of education (%)			
≤6	3.3	6.1	0.048
7–12	63.3	59.2	0.036
>12	43.4	34.7	0.001
Smoking currently (%)	16.7	15.8	0.573

^a Data shown as mean ± SD or percent. Difference in men vs. women was determined using t-test or chi-square.

participants are shown in Table 1. BMI, family income, and years of formal education were higher among men than women.

Overall comments from focus group discussions

Data are presented according to emerging themes, supported by quotes that illustrate the response that adult participants of both genders and various obesity classifications and residential zones had for a specific issue. Four major topics emerged from the data. A

summary of the main barriers and motivators for consuming brown rice or a higher ratio of beans to rice is presented in Table 2.

Topic 1. Perceptions on rice and beans, and the currently consumed ratios

During the first session of the discussion, around 95% of participants perceived white rice as a food of little benefit to their health, while beans were considered very nutritive. Nonetheless, that perception seemed to have no influence over dietary habits (Table 3; comment 3.1).

In general, participants indicated that they eat a larger ratio of rice to beans because they considered rice to be the main dish, and that rice provides more satiety compared to beans (Table 3; comment 3.2). Furthermore, consuming more rice than beans was considered a traditional part of the Costa Rican food culture (Table 3; comment 3.3).

The habit of eating more rice than beans is reinforced at home as well as in other environments where people eat (Table 3; comments 3.4–3.5). In addition, participants expressed that rice, as opposed to beans, has various advantages that favor its consumption: better yield to feed more people, less cooking/preparation time, better taste, more versatility for its preparation, and lower cost (Table 3; comment 3.6). The lower consumption of beans compared to rice may also be explained by sensory preferences, effects on the stomach, and issues with cooking and preserving beans (Table 3; comments 3.7–3.9).

Topic 2. Consuming higher proportion of beans to rice

Except for a few isolated comments, the majority of participants considered that it would not be easy for them to eat higher

Table 2

Summary of main barriers and motivators for consuming brown rice or a higher ratio of beans to rice as mentioned by Costa Rican adults participating in focus groups and sensory tastings.

	Brown rice	Higher ratio of beans: rice
Barriers	<ul style="list-style-type: none"> Lack of familiarity and habit Taste is more inferior than white rice Negative sensory perceptions (taste, texture, color) High price Complexity of cooking White rice is too engrained in the culture Lack of perception as a disease-prevention food Lack of family support and acceptance 	<ul style="list-style-type: none"> White rice perceived as inherent of Costa Rican tradition Habit of eating more rice than beans is engrained in the culture Eating more rice than beans happens at home and when eating out White rice perceived as main dish; beans perceived as complement White rice lasts longer and is more versatile than beans Cooking beans takes a long time and is difficult Distaste for plain boiled beans Stomach distension caused by beans White rice perceived as more filling than beans White rice is inexpensive
Motivators and opportunities	<ul style="list-style-type: none"> Masking the taste, color, and odor in the recipe/preparation Introducing it in the diet at childhood Disseminating its health benefits (and white rice's lack thereof) Lowering cost Increasing availability at supermarkets Demystifying it as a weight loss food Women as agents of change Older adults can make change easier 	<ul style="list-style-type: none"> Beans are perceived as healthy and nutritious Willingness to try for health reasons Enhancing beans with other traditional flavors

Table 3

Quotes that illustrate the response that adults had for topic 1 "Perception on rice and beans, and the currently consumed ratios".

- 3.1 I have heard that beans are better than rice, that they have fiber and many nutrients. What happens is that by habit the plate has more rice than beans on most instances. . . [non-overweight woman, urban area].
- 3.2 I feel that rice fills you up more. If I didn't eat rice, I would feel a void. . . that (rice) is the food that sustains you. . . [overweight woman, rural area].
- 3.3 Throughout the whole life, less proportion of beans than rice has been served. . . [non-overweight man, urban area].
- 3.4 At home, it is almost automatic. I serve two or three spoonful of rice and one of beans. . . [overweight woman, urban area].
- 3.5 At the company's lunchroom, you see the proportion that they serve; it is always lots of rice and little beans. . . [overweight man, urban area].
- 3.6 Rice yields more servings after it is cooked, and it's very practical to cook, and it is also very versatile. It can be prepared with vegetables, with chicken, with shrimp. In contrast, beans involve a longer process for cooking. . . [non-overweight woman, urban area].
- 3.7 I like seasoned beans. . . but not beans as such, the sensation of biting into them is like waxy. . . [non-overweight man, rural area].
- 3.8 Beans are heavier on the stomach, there are people for who (beans) won't settle well. . . [non-overweight woman, urban area].
- 3.9 It depends if I prepare them (beans) that day, I may eat more beans than rice, we only like them fresh. . . [overweight woman, urban area].

Table 4

Quotes that illustrate the response that adults had for topic 2 “Consuming higher proportion of beans to rice”.

- 4.1 What satisfies us is to eat more rice than beans, independent of whether we obtain more benefits in terms of health. The primary thing is to be full. . . [non-overweight man, urban area].
 4.2 It is a tradition, I think us Costa Ricans like to eat more rice, and the beans are well seasoned. And besides, too much beans don't settle well to a person. . . [overweight man, rural area].
 4.3 If it was because of health, then I may try it, and that is an element that normally is not present in one's mind, because then it wouldn't be eating for pleasure but rather for health. . . [non-overweight man, rural area].

proportion of beans to rice, even after they were informed that such ratio would be optimal for preventing cardiometabolic diseases. The dislike for the taste of boiled beans, the habit of eating more rice, and the stomach distension caused by beans, were the main barriers for not consuming a higher ratio of beans to rice (Table 4; comments 4.1–4.2). Nonetheless, these barriers and initial negative reaction towards change do not seem to be straightforward, given that increasing the ratio of beans: rice was perceived as sacrificing the pleasure of eating in order to be healthier (Table 4; comment 4.3).

Topic 3. Brown rice perceptions

The majority of participants reported to have never tasted brown rice given that it is not a part of the Costa Rican dietary habits (Table 5; comments 5.1). Among those who had tasted brown rice, they did not consider it pleasant because of the sensory characteristics, the higher price, and the difficulty of preparing it (Table 5; comments 5.2).

Eating white rice is strongly engrained in the culture, which represented the main barrier for replacing it for brown rice (Table 5; comments 5.3). Consuming brown rice was not perceived as a dietary component that would contribute to reducing the risk of disease, and several participants commented that other dietary and lifestyle factors may influence disease more than, or in conjunction with, rice (Table 5; comments 5.4).

The lack of family support also seemed to inhibit the possibility of incorporating brown rice as part of the daily diet (Table 5; comments 5.5).

Food sensory testing

The ANOVA results indicated a significant effect of the type of food preparation on the overall rating of these ($F(6,401) = 5.727$, $P < 0.001$, $\eta^2 = 0.079$). We observed a significant effect on the appraisal of color ($F(6,393) = 10.034$, $P < 0.001$, $\eta^2 = 0.130$), odor ($F(6,389) = 7.159$, $P < 0.001$, $\eta^2 = 0.098$) and taste ($F(7,469) = 8.983$, $P < 0.001$, $\eta^2 = 0.118$) of each preparation. Texture had no significant effect on the appraisal of the type of food preparation ($F(2,107) = 2.553$, $P = 0.094$, $\eta^2 = 0.037$ (Table 6).

Plain brown rice was given the lowest mean score for overall characteristics (5.16 ± 2.14), color (4.76 ± 1.92), odor (5.00 ± 2.04), and taste (5.29 ± 0.26), and these scores were significantly lower compared to white rice or any of the bean: rice recipes. For taste, the preparations with the bean: brown rice ratio of 3:1 had a higher mean score than that plain brown rice ($P < 0.05$), suggesting that the presence of beans could improve acceptability of brown rice.

Among the mixed preparations, the beans: white rice ratio 1:1 received the highest overall score (6.53 ± 1.58), but this score was not significantly different from the 1:1 beans: brown rice score (6.15 ± 1.81). The lowest overall scores were given to the mixed preparations with the lowest proportion of beans to rice (1:3) re-

Table 5

Quotes that illustrate the response that adults had for topic 3 “Brown rice perceptions”.

- 5.1 Actually I don't have knowledge about brown rice because it has not been a part of the meals at my home. It may be good but I have never tasted it. . . [non-overweight man, urban area].
 5.2 That's because in general we like our rice white, whole, loose, and the other one (brown rice) is like dirty, more expensive, and it turns out doughy. . . [non-overweight woman, rural area].
 5.3 Sometimes (we) change things in the diet, but white rice is something that we religiously eat by tradition. . . [non-overweight man, urban area].
 5.4 People in the past lived many years and they ate white rice, beans, and cooked with pig lard. I think that brown rice does not make the difference, but rather the dynamic of the people. In the past, they moved more because of the type of jobs. . . they walked a lot. In contrast, now everyone is sedentary and eats a ton of fried stuff. . . [overweight woman, urban area].
 5.5 In my house, I have tried to change some of the dietary habits, but my husband tells me to cook rice normally and eat (my) stuff separately. And I won't cook two types of rice. . . imagine all the time and money spent! . . . [non-overweight woman, rural area].

Table 6

Scores for individual and overall sensory characteristic scores as assessed by a 9-point hedonic scale for each food preparation in the food sensory tasting^a.

Food preparation	Overall	Color	Odor	Taste	Texture
Beans: white rice, 1:1	6.53 ^{b,c} ± 1.58	6.49 ^c ± 1.6	6.58 ^c ± 1.55	6.58 ^c ± 0.20	6.44 ± 1.50
Beans: white rice, 1:3	5.65 ^{c,d} ± 1.92	5.46 ^{b,d} ± 2.12	5.88 ± 1.77	5.69 ^d ± 0.22	5.63 ± 1.98
Beans: white rice, 3:1	5.87 ^{b,c,d} ± 1.14	5.71 ^b ± 1.98	6.21 ^c ± 1.74	6.43 ^c ± 0.21	7.13 ± 4.79
Beans: brown rice, 1:1	6.15 ^c ± 1.81	6.13 ^c ± 2.09	5.91 ^c ± 2.05	6.18 ± 0.24	5.84 ± 2.19
Beans: brown rice, 1:3	5.31 ^{c,d} ± 1.89	5.28 ^{b,d} ± 1.89	5.58 ± 1.84	5.35 ^d ± 0.23	5.25 ± 1.80
Beans: brown rice, 3:1	6.09 ^{c,d} ± 1.84	5.47 ^{b,d} ± 2.18	6.49 ^c ± 1.65	6.89 ^{b,c} ± 0.20	6.00 ± 1.96
Plain white rice	6.38 ^{c,d} ± 1.75	6.78 ^c ± 1.70	6.24 ^c ± 1.64	5.87 ± 0.22	6.22 ± 1.92
Plain brown rice	5.16 ^{b,d,e} ± 2.14	4.76 ^{b,d,e} ± 1.92	5.00 ^{b,d,e} ± 2.04	5.29 ^{b,d} ± 0.26	5.07 ± 2.02

^a Values presented as mean ± SD score from a 9-point hedonic scale, with higher scores representing higher appraisal of pleasantness. Repeated measures analysis of variance with Bonferroni post hoc was used to determine significant differences ($P < 0.05$) in mean scores.

^b Significantly different from plain white rice, $P < 0.05$.

^c Significantly different from plain brown rice, $P < 0.05$.

^d Significantly different from beans: white rice ratio 1:1, $P < 0.05$.

^e Significantly different from beans: brown rice ratio 1:1, $P < 0.05$.

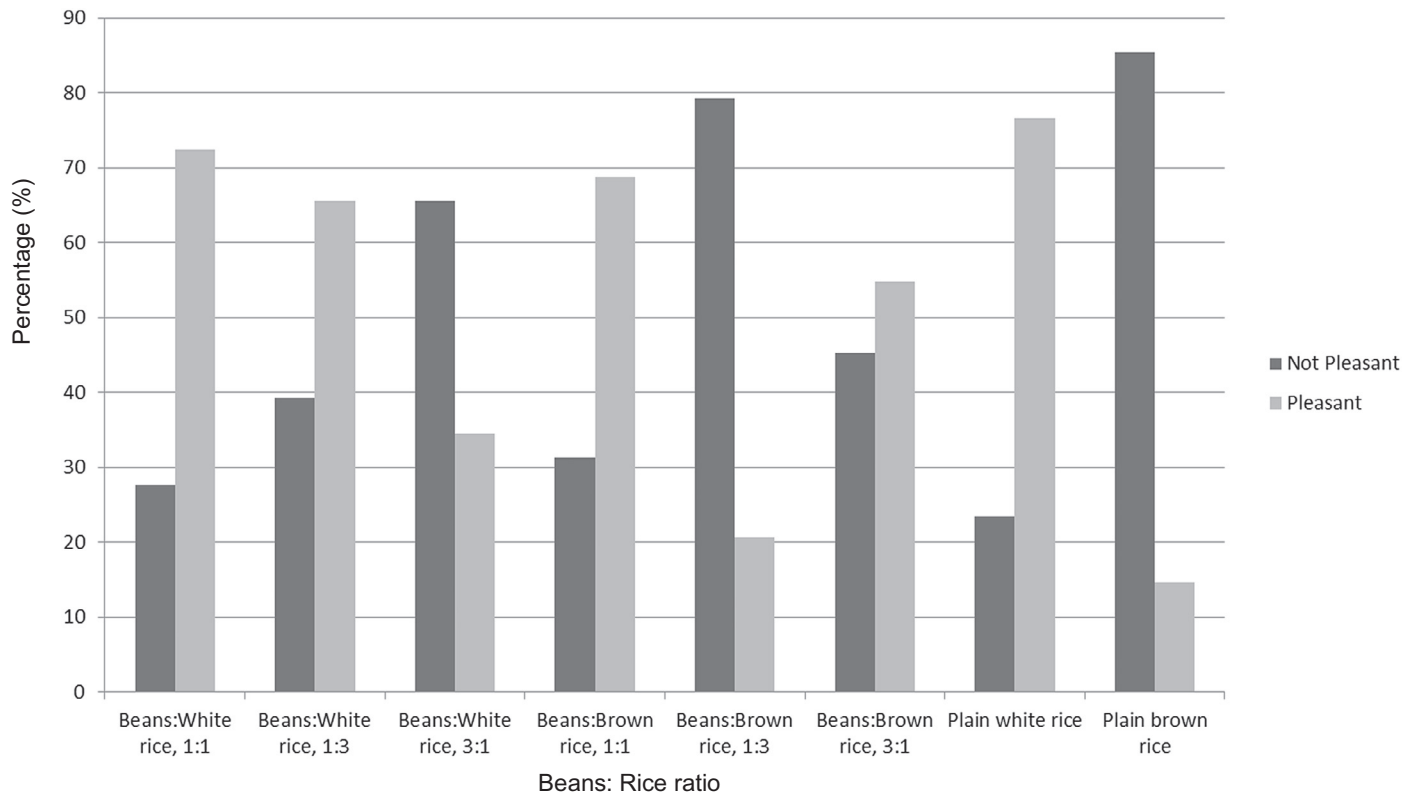


Fig. 1. Frequency of pleasantness ratings for each food preparation included in the food sensory tasting. 'Not pleasant' defined as those preparations that were scored in the range 1–5 points using a 9-point hedonic scale, 'Pleasant' defined as those preparations that were scored in the range 6–9 points using a 9-point hedonic scale.

ardless of the type of rice (5.65 with white and 5.31 with brown rice; $P < 0.05$ compared to the 1:1 bean: white rice preparation). Furthermore, the preparations with a higher bean: brown rice ratio (3:1) had a higher overall score than those with the 3:1 bean: white rice ratio (6.09 and 5.87), although not statistically significant.

Among the mixed preparations, liking of color and taste had the most influence on the overall score. There were not significant differences in liking of odor and texture between the mixed bean and white rice preparations.

The three preparations of combined beans and rice that were most rated as pleasant by participants were the 1:1 beans: white rice (72.4%), 1:1 beans: brown rice (68.7%) and the 1:3 beans: white rice (65.5%) (Fig. 1). The percentage of those who rated the recipes with high proportion of beans (3:1), regardless of type of rice, as unpleasant ranged from 45.2 to 65.5%. Only 23.4% of participants rated plain white rice as not pleasant, compared to 85.4% who rated brown rice as such.

Topic 4. Strategies for substituting brown rice for white rice

After the food sensory testing, several strategies to help promote brown rice as a substitute for white rice emerged from the participants' comments; for example: introducing brown rice in the dietary

habits during early childhood, disseminating the health benefits of brown rice, reducing its cost and making it more available at various markets and supermarket chains, and demystifying that eating brown rice is a weight loss strategy. A notable strategy suggested by participants was to improve the way of preparing brown rice, such that its distinctive color and odor, which were mostly considered unpleasant, were masked (Table 7; comments 7.1).

Both men and women agreed that it would be easier for women to replace white rice with brown rice; however the reasons for that differed by sex. Women suggested that they would make this dietary change because they are more concerned with health topics, and they also perceived themselves as agents of change. On the other hand, men said that women would make dietary changes easier because of their greater fixation with physical appearance, and because whole or light/diet food products are perceived as components of body weight self-management (Table 7; comments 7.2).

There was agreement among participants that adults would be more prone to switch the type of rice than adolescents, with the main reason being health, either because adults know more about the positive health effects of brown rice, or because they need to improve their health status (Table 7; comments 7.3).

Table 7

Quotes that illustrate the response that adults had for topic 4 "Strategies for substituting brown rice for white rice".

Topic 4: Strategies for substituting brown rice for white rice

7.1 By itself, I don't think people will eat it, but preparing it in various ways like in gallo pinto (a traditional stir-fry dish of left-over rice and beans, diced onions and other seasonings), rice and chicken with carrots and corn, then they would eat it. . . [non-overweight woman, urban area].

7.2 Women, because we are more health conscious, we watch the morning programs where they talk about nutrition, we take care of ourselves more. Men do not go to the doctor, do not take care of themselves, do not listen to nutrition programs. . ." [overweight woman, rural area].

7.3 I think that adults would accept it more because they know the benefits. In contrast, adolescents don't, they eat anything, they don't care if it's good or not. . ." [non-overweight man, urban area].

Discussion

The food choice process is complex, dynamic and situational, and the value assigned to each food is defined by a personal food system (Connors, Bisogni, Sobal, & Devine, 2001). The results of our study suggest that Costa Ricans define their personal food system based primarily on two values: tradition (or familiarity) and sensory properties of foods. Similar to Costa Ricans, tradition led the choice in type of rice consumed for adults in Chennai, India (Kumar et al., 2011) and was perceived positively for consumption of beans by Puerto Rican adults (Mattei & Campos, 2014). Wetter et al. (2001) have noted that when a behavior is an integral part of a person's life, the likelihood of maintaining that behavior over the long term is very high. This is likely the case of eating white rice instead brown rice (and in larger amounts than beans) among Costa Ricans, for whom eating brown rice or too much beans may create a cultural identity conflict.

Sensory acceptability of traditional staple foods seems to be universally high-ranking in the food value system across populations worldwide (Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Lennernäs, Fjellström, Becker, Giachetti, Schmitt, Remaut de Winter, & Kearney, 1997; Mattei & Campos, 2014; Muhhi et al., 2013; Vasudevan et al., 2013; Zhang et al., 2010), including in our Costa Rican study. But studies conducted among Chinese, Indians, and US-Americans (Glanz et al., 1998; Vasudevan et al., 2013; Zhang et al., 2010) point to other crucial values, such as convenience, time and cooking constraints, and price. For our Costa Rican participants, these factors seem to play an indirect role. The differences in food values between countries highlight the peculiarities across populations, and the need for understanding perceptions and preferences within the context of the culture.

Among our Costa Rican participants, health was not considered an important food choice value or motivator to change diet habits, even when they knew about the health benefits of consuming less white rice or substituting it for brown rice, and of consuming more beans. In contrast, several studies in European and American countries show that healthy eating is a priority value for food choice (Glanz et al., 1998; Lappalainen, Kearney, & Gibney, 1998; Lennernäs et al., 1997; Pettinger, Holdsworth, & Gerber, 2004; Ree, Riediger, & Moghadasian, 2007). Participants did comment, however, that they could adopt brown rice in their diet if they perceived a risk to their health or experienced a health issue themselves. This observation is related to the “optimistic bias” or “unrealistic optimism”, which is linked to the belief that if the health problem has not yet appeared, it is unlikely to occur in the future (Miles & Scaife, 2003). It has been proposed that if people believe that their diets are already healthy, whether or not they consciously strive for this, it may be unreasonable to expect them to alter their diets, or to consider nutrition/healthy eating as a food value priority (Kearney, Kearney, Dunne, & Gibney, 2000). For Costa Ricans, who commented that they did not consider their current eating habits as detrimental, this may be a key barrier to overcome for any intended dietary change.

Lack of knowledge of the nutritional content of healthy staple foods seems to be a barrier for healthy eating in other populations (Kumar et al., 2011), but not in our Costa Rican group, who expressed that brown rice and beans were nutritious and better choices than white rice. On the other hand, nutritional knowledge has been perceived as a possible motivator for including brown rice in the traditional diet (Vasudevan et al., 2013; Zhang et al., 2010) and for consuming legumes (Mattei & Campos, 2014). Our participants suggested a willingness to add more beans than rice for health reasons, and a possible positive influence on their dietary behaviors from learning about brown rice's health benefits; thus, such strategies may be practical for health-promotion programs in this population. Any such program, however, should address other bar-

riers and motivators in the personal food value and hierarchy as well as individual motivations for change, because good nutritional knowledge level alone does not necessarily translate into healthy food choices (Wądołowska, Babicz-Zielińska, & Czarnocińska, 2008), and individual motivation to change is also necessary (Glanz, Rimer, & Viswanath, 2008).

For Costa Ricans, white rice and beans (in lower amounts) are atop of their food value/hierarchy system, with brown rice not appearing on that list at all. Having white rice so highly valued makes incorporating brown rice or higher bean amounts a hard sell, especially when this value is perpetuated generationally, as suggested by participants' comments. People usually do not enjoy changing the routine that works for them (Connors et al., 2001), and our results suggest that norms about foods and meal composition that guided previous generations still provide new generations with a food hierarchy and eating structure for them to follow.

Along these lines, the symbolic function that the white rice and beans have on the Costa Rican cultural identity may explain the similar results that we observed between urban/rural and overweight/non-overweight participants. White rice and beans constitute the staple foods of the Costa Rican diet across the whole population, and this may generate a collective association towards a local food culture and reinforce the sense of identity (Kittler, Sucher, & Nahikian-Nelms, 2012).

In addition to readjusting the current cultural perceptions of the food hierarchy, it seems that mixing the brown rice with beans or other known recipes improves the sensory perceptions of brown rice here. As we mentioned above, several studies have shown that sensory perceptions have considerable influence on food choices, and they have been considered the limiting factor and less likely to be negotiable among food choices (Adams & Engstrom, 2000). For example, our participants particularly disliked the color, odor, and taste of brown rice, unless it was used in a combination already known and accepted by them (e.g. gallo pinto). Nonetheless, this observation supports the notion that including some familiar foods (such as beans), or enhancing sensory characteristics with traditional condiments as those used for gallo pinto, may help Costa Ricans adopt a new food (i.e. brown rice) in their food hierarchy.

Time constraints and convenience represented barriers to enhance the sensory appeal of beans and brown rice. Both foods require a long and complicated cooking process. In addition, participants commented that in Costa Rican culinary tradition, enhancing the taste of beans requires a second cooking process to add local chopped herbs and vegetables such as coriander, sweet peppers, onion, and garlic after they have been soaked and boiled for the first time. Therefore, practical information or knowledge that transfers skills (e.g., obtaining recipes, ideas on storing prepared beans or partially cooked brown rice) may lead to positive change in beans and brown rice consumption. Research suggests that the type, amounts, and convenient storage of food available at home may positively impact on the eating behavior of adults and youth (Larson & Story, 2009).

Our results indicated that the habits of eating a food in a particular way such as the 1:1 bean to white rice ratio are reinforced by family interactions and when eating outside the home. This suggests that social and family support should be part of the strategies to promote healthy eating behaviors. A food environment that supports healthy food choices may help facilitate and sustain individual dietary change (Larson & Story, 2009). In Costa Rica, promotion of beans and brown rice may be expanded to work, school, and community settings, such as work cafeterias and “sodas” (local eateries). It is particularly important, because brown rice and beans have a high fiber content and low glycemic index, which increases satiety and contributes to the prevention of major nutrition-related chronic diseases (Chang, Hong, Jung, & Suh, 2014; McCrory, Hamaker, Lovejoy, & Eichelsdoerfer, 2010; Rodrigues, Proença, Calvo, & Fiates, 2012).

As for family support, participants commented that women were perceived as early adopters of dietary changes around rice and beans, and the ones who would promote such changes in the family context. This finding is consistent with those from other surveys that suggest that women may act as nutritional gatekeepers, further influencing the dietary behaviors of family members (Chadwick, Crawford, & Ly, 2013; Connors et al., 2001; Larson & Story, 2009). However, several studies have shown that introducing healthier foods is often met with resistance from family members who refuse to eat them, generating a conflict between family members (Connors et al., 2001; Gillespie & Johnson-Askew, 2009; Kearney et al., 2000). In agreement with Lawrence and Barker (2009), we observed that Costa Rican women tended to place a higher priority on maintaining stability in the family relationships by providing the foods desired by the other family members rather than on persisting with efforts to provide healthy food choices. Still, the role of women on possible dietary interventions should be emphasized.

The gender stereotype that we observed here is also consistent with studies stating that women are more inclined to adopt healthy diets due to their greater concern about weight control and health topics (Newcombe, McCarthy, Cronin, & McCarthy, 2012; Vartanian, Herman, & Polivy, 2007). Gender stereotypes influence eating behavior because of people's desire for social approval (Newcombe et al., 2012; Vartanian et al., 2007). As a result, men give lower priority to health compared to other considerations such as taste or convenience in making food choices, because following healthy behaviors is associated with femininity rather than masculinity (Courtenay, 2000; Lyons, 2009; Vartanian et al., 2007; Wardle et al., 2004).

In summary, our results suggest the need to design public health programs that would help Costa Rican adults adapt their food choices into healthier ones within their cultural context. The strategies could identify novel ways to motivate change in eating behavior based on tradition and family as opposed to health and nutrition. For example, providing tasty, culturally-acceptable healthy food such as brown rice and beans in school-lunch programs and in the family context could promote the development of healthy eating habits among younger generations. Additionally, the availability of dishes prepared with brown rice in the work site cafeterias, and in the casual dining restaurants could reinforce the adoption of novel eating habits. Understanding the values related to food choices is the first step in designing successful health promotion intervention to increase the beans consumption and to replace white rice with brown rice. Using this valuable information could provide urban and rural Costa Rican adults with the necessary knowledge and skills to redefine their personal food system, without sacrificing taste or tradition in the pursuit of healthier food choices.

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