



## Research report

Food menus evaluation for most liked products in children from *Puna*, region of Argentina ☆María Cristina Goldner<sup>a,\*</sup>, Gerardo Lescano<sup>b,c</sup>, Margarita Armada<sup>a,b,c</sup><sup>a</sup> Instituto para la Investigación de la Industria Química (INIQUI) – Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Av. Bolivia 5150, 4400 Salta, Argentina<sup>b</sup> Facultad de Ingeniería, Universidad Nacional de Salta (UNSa), Av. Bolivia 5150, Salta, Argentina<sup>c</sup> Consejo de Investigación de la Universidad Nacional de Salta (CIUNSa), Av. Bolivia 5150, Salta, Argentina

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## ABSTRACT

The aim of this study was to investigate the acceptability of varied food menus, preferred by children of 11–14 years located at *Puna* (3500 m.a.s.l.), in young urban people. The children drew “the preferred menu” which showed that the consumption of vegetables as a main course was comfortable when it was consumed in the form of soups and mixed vegetables. However, some imbalances were detected when evaluating the percentage of daily nutritional values and the caloric distribution of nutrients. Consumer’s hedonic scores showed significant acceptability to the cheese *empanadas*, Andean potato cake and Andean mashed potato. The free word association test suggested that, because of their relationship with culture, the Andean mashed potato, *verde* potato stew with *charqui* and *anchi* of apple could be offered as a traditional food. The acceptability of meals was largely related to the meals having the highest input of energy, fat and carbohydrates but containing the least content of protein and dietary fiber.

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## Introduction

Inhabitants of the *Puna* (an arid highland region located at 3500 m above sea level) have a specific ethnic background of *Quechuas* and *Aymaras* admixture. Eating behavior is a deeply rooted cultural trait interlaced with mythology, religion and medicine. Each culture generates a series of ideas and beliefs about the supposed virtues or properties that foods possess. This cultural diet constitutes barriers to the adoption of new foods which perhaps, may be more effective from a nutritional point of view (Santoni & Torres, 2002).

Andean population is characterized as having malnutrition status (Morales, Aguilar, & Calzadilla, 2004; Post, Lujan, San Miquel, & Kemper, 1994). Particularly in the *Puna* and the *Quebrada de Humahuaca*, regions of Argentina, several cases of malnutrition have been demonstrated. Studies indicate this is caused by the transition from an Andean-like to a Western-like diet (Damman, Wenche, & Kuhnlein, 2008; Romaguera et al., 2008). This is a situation being addressed with food aid programs; but one problem

with government food aid is that the food relief is sent to the wrong population (Grivetti, 2004) because sensory acceptability is not taken into account. It is known that food choice and acceptability are primarily based on whether sensory properties are liked or disliked. Nutritional benefits remain as a secondary concern. For this reason, it is imperative to study the nutritional characteristics of meals that are liked most in the *Puna*. This would provide the opportunity to improve food quality using ingredients and foods which this population knows and accepts.

Another phenomenon that happens in this region is “gastro-nomic or culinary tourism”. Since UNESCO included the “culinary arts” in its definition of intangible heritage in 1989, food characterized as “products and traditional dishes” creates an active heritage (Álvarez & Sanmantino, 2009). Within this context, the concept of “culinary tourism” evolves through food exhibitions, food festivals, restaurants, and specific locations in which food tasting as well as the cultural experience is a primary factor for travel (Hall & Mitchell, 2000). However, food is more than eating (Hall & Mitchell, 2000). Food relates to issues of identity, culture, production, consumption and sustainability (Okumus, Okumus, & McKercher, 2007).

Association to an alleged origin in local or regional food culture is seen as an attractive way to interest the urban consumer in new food product brands (Tellström, Gustafsson, & Mossberg, 2006). Also, recent concerns for food quality and safety have stimulated demand for locally grown and organically produced foods. This is reflected by the number of gourmet restaurants serving dishes

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\* Corresponding author.

E-mail address: [crisstigol@gmail.com](mailto:crisstigol@gmail.com) (M.C. Goldner).

based on indigenous products (Devaux et al., 2009). Consequently, it is important to study the sensory acceptability and how the concepts of meals of the *Puna* are perceived by the urban population. This allows the possibility to incorporate new courses in their diet, and for the economic improvement of this region of Northwest Argentina to become an international tourist region.

In the framework of the Andean food revaluation, this study meant to identify whether the preferred products of children from the *Puna* can be liked by the urban population and what concepts are associated. Moreover, their nutritional composition was studied in order to contribute to food aid programs and nutrition information labeling on menus (National Heart Foundation of Australia, 2010).

It should be mentioned that *Punás* children walk up to 7 km to get the school. They generally eat one portion of what is considered their main meal of the day. Lunch is the largest meal and contributes the most energy and nutrients. We focused the attention to one menu (the preferred menu) to contribute to the studies of lunches independent of food eaten during the rest of the day as Vossenaar et al. (2011) suggested.

## Materials and methods

### Fieldwork, participants and data collection

A trip to a little rural village 3800 m above sea level (12,467 ft.) in the *Puna* of Salta Province, Rep. Argentina was made with the “Fundación Nuestra Señora de la Luz” (a non-governmental organization). Twenty students of the State school, 12 females and 8 males, 11–14 years (mean age = 12.29 years,  $SD = 0.986$ ), representing approximately 70% of the pupils belonging to this age range, participated in this study. They were asked to draw and write the recipe of their preferred menu, the dish and dessert (Table 1). This method was used in order to obtain information which cannot be obtained in an oral or a conscious manner (Cabezas López, 2007). Drawing requires little or no training for the child and also represents a natural activity that is spontaneous, with high participation and, usually enjoyable (Saneei & Haghayegh, 2011). An adult assisted the children with the redaction of the recipes. The size of each portion was estimated according to Jorge (1996) and Gómez and Maturano (2005). The activity was approved by the authorities of the institution and performed during 2 h.

### Dietary intake

Estimated energy, macronutrients and selected micronutrients for each main course and dessert drawn by the children were determined using the software ALIM 1.0.04 (Lescano & Del Castillo, 2010) according to the USDA National Nutrient Database (release 22) and the *Reglamento Técnico Mercosur* (GMC/RES. no. 46/03) using recommended nutrient intakes as standard references.

### Free word association test

The experiment was carried out in the *Laboratorio de Alimentos, Facultad de Ingeniería (Universidad Nacional de Salta)*. A panel leader explained the procedure for carrying out the test before the samples were presented. Consumers were trained in the elicitation of the three words with the words “cat” and “house”. For example, if the word “house” was said: *what were the first three words that come to their mind?* Sample responses may include: mother, garden, family, etc. The test started when the consumers expressed they were ready to begin. The free word association test consisted of presenting the course or dessert and eliciting up to three words

of response. The maximum time of the test was 30 s. This test was applied following the guide of Guerrero et al. (2010).

### Acceptability test

The experiment was carried out in parallel with the free word association test. Sixteen meals (12 foods and 4 desserts) were selected according to the degree of cultural belonging (Table 2). *Milanesa* and *asado* were omitted since it is well known the acceptability the Argentinean population traditionally have for high consumption of animal protein and fats obtained mainly from red meat (Navarro et al., 2004). Gelatin and biscuits with *dulce de leche* were also omitted because these desserts are not traditional in the Andean area.

Three groups of four foods each and one group of four desserts were constructed (Table 2). Each group was tested by 112 consumers (Hough et al., 2006) which is a total of 448 consumers (256 female and 192 male, 4 groups  $\times$  112, students of the *Universidad Nacional de Salta*) according to Sosa and Hough (2006). Subjects were informed of the name of each meal and instructed both verbally and in writing to: (1) respond if she/he knew this course and if she/he consumes this course, and (2) rate the pleasantness of the dishes. Acceptability of selected foods was assessed using a 9-point hedonic scale with 1 being “dislike extremely” and 9 “like extremely” (Lawless & Heymann, 1998). The presentation was monadic with 5 min of break between samples. Salt and water *ad libitum* were provided. The dishes were served in plates at  $50 \pm 2$  °C and the desserts in cups at  $10 \pm 2$  °C.

### Data analysis

Frequency analysis was used to study the ingredients, both industrialized and otherwise, and the types of courses. In order to determine differences, the theoretical dietary intakes and the caloric distributions of menus were compared against recommended values by the *t*-test. The intake of each menu was divided by the recommended nutrient intake to determine the percentage daily value. Mean and standard deviations were also calculated.

The words elicited from participants (all Spanish speaking) were translated to English and grouped in different categories of words with the aid of *Diccionario de la Real Academia Española* (<http://buscon.rae.es/draef/>). Frequency of elicitation was obtained for each category. Frequency analysis was performed for each response of consumers and the *z*-test to compare percentages of known, unknown, consumed and non-consumed meals.

Sensory acceptability of meals was evaluated by ANOVA considering the course as a fixed factor nested in each group, and the consumers as random nested in gender. Effect sizes (partial  $\eta_p^2$ ) were calculated. When significant effects were detected, multiple comparisons of means were conducted using Tukey's honestly significant difference (HSD) test.

Multiple Correspondence Analysis was performed with frequency data of categories of word association; known, unknown, consumed, and non-consumed meals, and the hedonic response. A Principal Components Analysis (PCA) was conducted to correlate sensory acceptability, nutritional composition and meals; a correlation matrix was used and the minimum eigenvalue was set at 1. Finally, the factors scores were subjected to Hierarchical Cluster Analysis to group meals with similar patterns based on the macronutrient composition and the acceptability. The sample similarities were calculated on the basis of the squared Euclidean distance, and the Ward method was used to establish clusters.

All statistical analyses were performed using Infostat v.2009p<sup>®</sup>, registered by *Universidad Nacional de Córdoba* (Córdoba, Argentina) and  $p < 0.05$  was considered statistically significant.

**Table 1**  
Menus and theoretical ingredients drawn by children and size of the portions.

No.	Menu	Theoretical ingredients	Portion (g) (course + dessert)
1	Pizza and gelatin	Wheat flour, tomatoes, onions, yeast, salt, cheese, olives. Gelatin	250 + 150
2	Andean mashed potato and <i>anchi</i> <sup>a</sup> of lemon	Andean potatoes, milk. Corn flour, juice of lemon, sugar	280 + 160
3	<i>Puchero</i> <sup>b</sup> and gelatin	Andean potatoes, carrots, onions, chard, pepper, pumpkins, celery, parsley, meat ( <i>osobuco</i> <sup>c</sup> ), oil. Gelatin	250 + 150
4	<i>Milanesa</i> <sup>d</sup> with mashed potato and gelatin	Eggs, breadcrumbs and meat. Andean potatoes, milk. Gelatin	350 + 150
5	Pizza of onion and gelatin	Wheat flour, onions, yeast, salt, cheese. Gelatin	250 + 150
6	Vegetable soup and gelatin	Andean potatoes, carrots, onions, chard, celery, parsley, pumpkin. Gelatin	250 + 150
7	Cheese <i>empanadas</i> <sup>e</sup> and rice with milk	Wheat flour, yeast, beef fat, cheese, Andean potatoes, scallion. Rice, milk, sugar and cinnamon	300 + 200
8	<i>Salpicón</i> <sup>f</sup> of chicken and <i>anchi</i> of apple	Andean potatoes, onions, tomatoes, chard, radish, red peppers, peas, hard-boiled eggs, juice of lemon, chicken, oil. Corn flour, juice of lemon, sugar, apples, raisin	300 + 160
9	<i>Puchero</i> and fruit salad	Andean potatoes, carrots, onions, chard, pepper, pumpkins, celery, parsley, meat ( <i>osobuco</i> ), oil. Apples, pears, oranges	300 + 120
10	<i>Verde</i> <sup>g</sup> potato stew with meat and <i>anchi</i> of apple	<i>Verde</i> potatoes, pumpkins, onions, carrots, tomatoes, <i>carnaza</i> <sup>h</sup> , cumin, oil. Corn flour, juice of lemon, sugar, apples, raisins	300 + 160
11	<i>Salpicón</i> of meat and rice with milk	Andean potatoes, carrots, tomatoes, peas, pepper, pumpkins, onions, mayonnaise, meat. Rice, milk, sugar and cinnamon	300 + 200
12	Oat soup and biscuits with <i>dulce de leche</i> <sup>i</sup>	Oat, Andean potatoes, carrots, pumpkins, <i>osobuco</i> . Biscuits and <i>dulce de leche</i>	300 + 50
13	<i>Verde</i> potato stew with <i>charqui</i> <sup>j</sup> and <i>anchi</i> of lemon	<i>Verde</i> potatoes, pumpkins, carrots, onions, tomatoes, <i>charqui</i> , pepper, cumin, oil. Corn flour, raisins, sugar, cinnamon	300 + 160
14	<i>Salpicón</i> of vegetables and gelatin	Andean potatoes, carrots, tomatoes, pepper, lettuce, peas, red pepper, hard-boiled eggs. Gelatin	250 + 150
15	<i>Asado</i> <sup>k</sup> with salad and fruit salad	Ribs, lettuce, tomato, oil. Apple, oranges, pears	450 + 120
16	Vegetable soup and <i>anchi</i> of lemon	Andean potatoes, carrots, onions, chard, pumpkins, celery, parsley. Corn flour, juice lemon, raisins, sugar	300 + 160
17	Andean potato cake and gelatin	Andean potatoes, onions, <i>carnaza</i> , hard-boiled eggs, pepper. Gelatin	300 + 150
18	<i>Verde</i> potato stew and <i>anchi</i> of lemon	<i>Verde</i> potatoes, pumpkins, carrots, tomatoes, onions, oil. Corn flour, raisins, juice of lemon, sugar	300 + 160
19	Noodle soup and gelatin	Andean potatoes, carrots, onions, pumpkins, peppers, noodles, oil. Gelatin	300 + 150
20	<i>Salpicón</i> of meat and rice with milk	Andean potatoes, carrots, tomatoes, peas, peppers, pumpkins, onions, meat. Rice, milk, sugar and cinnamon	300 + 200

<sup>a</sup> Popular dessert of the Northwest of Argentina.

<sup>b</sup> Traditional Argentine stew.

<sup>c</sup> Part of the cow spine.

<sup>d</sup> Lean beef dipped into eggs covered with bread crumbs and then fried in hot oil.

<sup>e</sup> Traditional dough round filled with cheese (like Cornish Pasties in England).

<sup>f</sup> Name of a mixture of vegetables with or without chicken or meat.

<sup>g</sup> Name of a variety of Andean potato with a characteristic green color.

<sup>h</sup> Part of the cow palette.

<sup>i</sup> Sweetened condensed milk very popular in Argentina. It is produced by concentrating milk to a minimum of 68% total solids by boiling in the presence of added sucrose.

<sup>j</sup> Strip of salted meat exposed to the sun for several days to dry it.

<sup>k</sup> A traditional barbeque dish in Argentina that consists of meat, *chorizo* (fresh sausage), *morcilla* (black pudding), *molleja* (sweetbread) and other meats cooked on hot coal or native wood on direct flame.

## Results

### Analysis of the drawings

Twenty menus were recorded which combined 18 dishes and six desserts (Table 1). All were homemade or eaten at school. A total of 51 ingredients were drawn, 20 of which (39%) were industrialized: wheat flour, corn flour, sugar, rice, raisin, biscuits, *dulce de leche*, juice, mayonnaise, oil, yeast, cheese, vinegar, chicken, oat, olives, cinnamon, salt, gelatin and noodles. The remaining 61% (31 ingredients) were locally produced or acquired in a local market (lemons, apples, grapes, pineapples, oranges, mandarins, strawberries, pears, cherries, varieties of Andean potato, carrots, pumpkins, peppers, onions, tomatoes, *charqui*, meats, *osobuco*, milk, eggs, cumin, paprika, lettuce, peas, scallion, radishes, chard, celery, parsley, breadcrumbs and broth).

The most frequent courses were varieties of soups (vegetable, oat and noodle) and *salpicón* (of vegetables, chicken or meat) named four times each, followed by a *verde* potato stew (with or without *charqui* or meat) which was named three times. Pizza, mashed potato and *puchero* were drawn by two children and the remaining meals, *milanesa*, cheese *empanadas*, *asado* with salad

and Andean potato cake were once cited. The most frequent ingredient cited was the Andean potato (in 17 of 20 menus) followed by onions (in 13 of 20 menus), carrots (in 11 of 20 menus) and pumpkins (in 9 of 20 menus). The method of cooking for all meals was boiling and stewing in water, with the exception of frying for *milanesa* and barbecuing for *asado*. Wood stoves were used as the heat source. Curiously, stews, soups and *salpicón* based on a mixture of vegetables were generally what this group of children preferred to eat.

In the study concerning desserts, 40% of the menus (8 of 20), the gelatin was the dessert most preferred. This revealed a change in the food habits by replacing native for industrialized foods. In second place, two varieties of the traditional *anchi* (lemon or apple) were mentioned in six menus, following by rice with milk (in 3 of 20 menus), fruit salad (in 2 of 20 menus) and biscuits with *dulce de leche* (in 1 of 20 menus).

### Energy, nutrient intakes and percentage daily values of each menu

Theoretical energy intake per portion of the favorite menus (mean = 506, *SD* = 276 kcal) was less,  $t(15) = -12.306$ ,  $p < 0.001$ , than required for a lunch (700 kcal, 35% of 2000 kcal/day) (Tojo

**Table 2**  
Groups of meals, ingredients used and mode of preparation for the acceptability test.

	Ingredients	Preparation
<i>Meal</i>		
Group no. 1		
Andean potato cake	Mashed <i>cuarentona</i> <sup>a</sup> potatoes, cubed meat ( <i>carnaza</i> ), chopped hard-boiled eggs, cubed red peppers and chopped onions	Boil the meat. Boil the Andean potatoes with the skin. Mix the meat with the egg, red pepper and onion and put them between two layers of mashed potatoes
Andean mashed potato	Mashed <i>imilla</i> <sup>a</sup> potato, milk	Boil the potatoes with the skin, add milk
Salpicón of vegetables	Cubed <i>runa</i> <sup>a</sup> potato, cubed red pepper, onion, cubed carrot, cubed tomato, pea, chopped hard-boiled egg	Boil the Andean potatoes with the skin. Mix all ingredients. Add sunflower oil. Serve cold
Oat soup	Oat, cubed meat ( <i>osobuco</i> ), cubed <i>cuarentona</i> potato, broth of vegetables	Boil the oat into the broth with the meat and potatoes with the skin
Group no. 2		
Pizza	Dough: wheat flour, yeast, salt, water. Cheese, sliced tomato, chopped onion, olives	Make the dough and being fermented for 30 min. Stretch; add the onion, cheese and tomato. Cook into the oven
<i>Puchero</i>	Pieces of meat ( <i>osobuco</i> ), pieces of <i>runa</i> and <i>cuarentona</i> potatoes, pieces of <i>oca morada</i> <sup>a</sup> , <i>oca amarilla</i> <sup>a</sup> , onion, pepper, and pumpkin, chopped chard, chopped carrot, sunflower oil	Boil all ingredients in water with occasional stirring
Salpicón of meat	Meat ( <i>carnaza</i> ), cubed <i>runa</i> potato, cubed red pepper, chopped onion, cubed carrot, cubed tomato, pea, hard-boiled egg	Boil the meat and Andean potatoes with the skin. Mix all ingredients. Add sunflower oil. Serve cold
Noodle soup	Broth of vegetables, noodles	Boil the noodles into the broth
Group no. 3		
Cheese <i>Empanadas</i>	Dough: wheat flour, fat, salt and water. Filling: cheese, chopped scallion	Make the dough. Place fillings by tablespoonfuls into dough rounds. Fold over and seal, bake in hot oven
Verde <sup>a</sup> potato stew with <i>charqui</i>	Cubed <i>verde</i> potato, chopped <i>charqui</i> , cubed tomato, chopped onion, red pepper, cubed pumpkin, cubed carrot, sunflower oil	Boil all ingredients in water with occasional stirring
Salpicón of chicken	Chopped chicken, cubed <i>runa</i> potato, cubed red pepper, chopped onion, cubed carrot, cubed tomato, pea, hard-boiled egg	Boil the chicken and Andean potatoes with the skin. Mix all ingredients. Add sunflower oil. Serve cold
Vegetable soup	Cubed <i>runa</i> and <i>cuarentona</i> potato, <i>oca amarilla</i> and <i>morada</i> , chopped onion, cubed pumpkin, chipped chard, pea, celery and parsley, cubed carrot and sunflower oil	Boil all ingredients in water with occasional stirring
<i>Desserts</i>		
Group no. 4		
<i>Anchi</i> of lemon	Grits, lemon, raisin and cinnamon	Boil all ingredients in water with occasional stirring. Serve cold
<i>Anchi</i> of apple	Grits, apple slices, lemon, raisin and cinnamon	Boil all ingredients in water with occasional stirring. Serve cold
Rice with milk	Rice, milk and sugar	Boil the rice with the sugar and the milk
Fruit salad.	Cubed apple, orange and pear	Mix all ingredients. Serve cold

<sup>a</sup> Different varieties of Andean tubers.

Sierra & Leis Trabazo, 2007) and only three menus surpassed this value: menu no. 7, no. 11 and no. 15 (Table 1) (data not shown).

Table 3 shows the mean percentage daily values of energy of each selected nutrient for the 20 menus with respect to the recommended daily diet which includes the range of such values. Generally, all the menus provided around a quarter of the energy necessary for a day. However, vegetable soup and gelatin, and cheese *empanadas* and rice with milk were the menus with the lowest and the highest percentages respectively. The mean percentage daily values for the macronutrients were between 21.5% and 34.5% (Table 3). The *asado* with salad and fruit salad was the menu with the most input of protein and fat, and the least input of carbohydrates. In relation to minerals, the mean daily values were from 11.3% (Ca) to 69.3% (Se) with *puchero* and gelatin providing the least contribution (2.3% Ca) and *verde* potato stew with *charqui* and *anchi* of lemon, *asado* with salad and fruit salad and, cheese *empanadas* and rice with milk which surpassing the requirements (Table 3). All vitamins ranged from a mean of 13.4% (vitamin E) to 82.1% (vitamin A). It is important to note the absence of vitamin B12 in the *verde* potato stew and *anchi* of lemon as well as the excess of it in the *asado* with salad and fruit salad. Also, it was observed there was an excess of vitamin A in the *verde* potato stew and *anchi* of lemon and also an excess of vitamin K in the *salpicón* of chicken and *anchi* of apple. These examples denote, in some cases, an imbalance of certain nutrients when combining the main course and dessert. Observing the “minimum” column of Table 3, it can be seen that the menu *puchero* and gelatin

was the worst concerning the daily values, nine times showing low input of Ca, Fe, Mg, P, K, Cu, vitamin B1, vitamin B2 and vitamin B3. Moreover, the most frequent dessert of minimum percentage daily values” was the gelatin, 15 times, showing its lack of nutrients. On the other hand, *asado* with salad and fruit salad was a combination that supplied the most nutrition with regard to protein, fat and Zn, Fe, P, K and vitamin B12; followed by *salpicón* of meat and rice with milk which offered vitamins B2, B5, E and total folate.

Finally, the evaluation of the caloric distribution revealed that the mean% of 20 menus was 15.8, *SD* = 5.43,  $t(19) = 0.658$ ,  $p = 0.518$  for proteins, mean% = 29.6, *SD* = 16.0%,  $t(19) = -0.126$ ,  $p = 0.901$  for fats and mean% = 54.6, *SD* = 18.3%,  $t(19) = -1.309$ ,  $p = 0.206$  for carbohydrates. This distribution was similar to recommended levels – 15.0%, 30.0% and 60.0% respectively – (Vicario & Bartrina, 2007). Therefore, only five menus (no. 1, no. 5, no. 10, no. 14 and no. 16, Table 1) were associated more accurately with the above distribution (data not shown). The rest of the combinations of main courses and desserts showed discrepancies, mainly due to the absence of protein, lack or excess of fat from lack of meat or beef cuts with a lot of fat, or due to the excess of carbohydrates when the dessert was *anchi*.

#### Questionnaires

Table 4 shows the z-values from the comparison of proportions between known/unknown and consumed/non-consumed meals. The polls showed that all meals were known between 61.6% and



**Table 3**  
Descriptive analysis of percentage daily values of energy, macro and selected micronutrients of 20 menus.

	DRI	Mean	SD	% Daily values	
				Minimum (menu)	Maximum (menu)
Energy	2000 kcal/d	25.3	13.8	7.8 (Soup of vegetables and gelatin)	61.9 (Empanada of cheese and rice with milk)
Protein	75 g/d	26.3	16.7	5.8 (Stew of verde potato and anchi of lemon)	66.9 (Asado with salad and fruit salad)
Fat	56 g/d	34.5	36.4	4.3 (Mashed Andean potato and anchi of lemon)	156 (Asado with salad and fruit salad)
Tot. carbohydrates	300 g/d	21.5	10.6	7.2 (Asado with salad and fruit salad)	55.8 (Empanada of cheese and rice with milk)
Tot. dietary fiber	25 g/d	16.8	5.6	6.9 (Soup of noodles and gelatin)	26.7 (Mashed Andean potato and anchi of lemon)
Ca	1000 mg/d	11.3	10.9	2.3 (Puchero and gelatin)	37.3 (Pizza and gelatin)
Fe	14 mg/d	17.1	8.8	6.2 (Puchero and gelatin)	42.8 (Asado with salad and fruit salad)
Mg	260 mg/d	21.8	7.3	10.6 (Puchero and gelatin)	34.6 (Salpicón of chicken and anchi of apple)
P	700 mg/d	39.0	19.2	14.5 (Puchero and gelatin)	72.9 (Asado with salad and fruit salad)
K	4700 mg/d	15.3	5.9	6.1 (Puchero and gelatin)	27.9 (Asado with salad and fruit salad)
Na	2400 mg/d	37.0	25.8	11.5 (Puchero and fruit salad)	100 (Stew of verde potato with charqui and anchi of lemon)
Zn	7.0 mg/d	48.8	33.6	11.0 (Salpicón of meat and rice with milk)	152 (Asado with salad and fruit salad)
Cu	0.9 mg/d	32.6	10.0	18.8 (Puchero and gelatin)	45.4 (Stew of verde potato with meat and anchi of apple)
Mn	2.3 mg/g	20.7	10.4	9.1 (Soup of noodles and gelatin)	55.3 (Empanada of cheese and rice with milk)
Se	34 mcg/d	69.3	48.8	11.2 (Salpicón of vegetables and gelatin)	162 (Empanada of cheese and rice with milk)
Vit. C	45 mg/d	53.2	33.4	10.1 (Empanada of cheese and rice with milk)	120 (Puchero and fruit salad)
Vit. B1	1.2 mg/d	20.5	7.9	7.3 (Puchero and gelatin)	41.8 (Milanesa with mashed potato and gelatin)
Vit. B2	1.3 mg/d	19.8	11.1	5.8 (Puchero and gelatin)	49.8 (Salpicón of meat and rice with milk)
Vit. B3	16 mg/d	27.6	19.3	8.7 (Puchero and gelatin)	77.1 (Milanesa with mashed potato and gelatin)
Vit. B5	5.0 mg/d	22.6	11.7	7.4 (Soup of vegetables and gelatin)	49.6 (Salpicón of meat and rice with milk)
Vit. B6	1.3 mg/d	45.3	25.3	14.0 (Pizza and gelatin)	92.8 (Milanesa with mashed potato and gelatin)
Folate	320 mcg/d	14.8	6.6	5.0 (Oat soup and cookies with dulce de leche)	23.5 (Salpicón of meat and rice with milk)
Vit. B12	2.4 mcg/d	70.0	77.0	0.0 (Stew of verde potato and anchi of lemon)	354 (Asado with salad and fruit salad)
Vit. A	4500 ui/d	82.1	78.4	2.2 (Mashed Andean potato and anchi of lemon)	251 (Stew of verde potato and anchi of lemon)
Vit. E	10 mg/d	13.4	15.7	1.6 (Mashed Andean potato and anchi of lemon)	68.5 (Salpicón of meat and rice with milk)
Vit. K	65 mcg/d	64.1	98.1	4.0 (Oat soup and cookies with dulce de leche)	399 (Salpicón of chicken and anchi of apple)

100% of respondents. The exceptions were verde potato stew with charqui which was significantly not known by more than four fifths of participants (84.8%) and the anchi of apple, which was not known by around two fifths (41.1%) of the participants. The difference between anchi of lemon, known by 89.3%, and anchi of apple is due to consumers responding "it is more common anchi with lemon than with apple". In the case of Andean potato cake, it was known by 89.3%, but consumers affirmed that they knew this course "with common potato" referring to the most accessible potato of the market. The same occurred regarding the Andean mashed potato known by 61.6%.

As to whether the meals are consumed or not, Andean mashed potato and oat soup were not consumed by 78.6% and 76.8% of those respondents, and three of the four tested desserts (rice with milk, anchi of lemon and anchi of apple) were not consumed by 61.6%, 62.5% and 90.2% of participants respectively in a significant way (Table 4). These results indicate that these foods are known but not liked; suggesting that they were known by young people, but they are not ready to accept the taste.

Concerning the dishes, pizza was the most consumed (75% of the respondents) followed by soup and salpicón of vegetables and salpicón of chicken which were consumed by around three fifths (60.7% and 58.9%). Regarding desserts, fruit salad was consumed by about four fifths of consumers (78.6%).

Finally, differences between consumers who ate or did not eat cheese empanadas, Andean potato cake, puchero, salpicón of meat and noodle soup were not significant (Table 4). All were around half of the sample (46.4–53.6%).

#### Consumers' hedonic scores

The ANOVA of hedonic scores denoted no effect of consumers, nested in gender, ( $F(445, 1321) = 1.114$ ,  $p < 0.076$ ,  $\eta_p^2 = 0.12$ ) and a highly significant effect of the courses ( $F(15, 1321) = 10.434$ ,  $p < 0.000$ ,  $\eta_p^2 = 0.01$ ) in the acceptability of meals. Table 5 shows the mean acceptability of selected culinary preparations within each group and the result of Tukey's HSD test conducted after the

ANOVA. As can be seen, Andean potato cake and Andean mashed potato had a higher ( $p < 0.05$ ) score than salpicón of vegetables and oat soup. Pizza was liked more than puchero, salpicón of meat and noodle soup ( $p < 0.05$ ). Cheese empanadas were liked more than verde potato stew with charqui, salpicón of chicken and vegetable soup ( $p < 0.05$ ); and finally between the desserts, the highest ranked was the fruit salad (Table 5).

#### Free word association test and correspondence analysis

A total of 1344 words were elicited by 448 urban consumers. All respondents could respond with three words for each sample. However, only 43 words were different indicating that the same words were repeated by a lot of respondents. Examples of them were: mother, home, family, grandmother, baby, winter, summer, hot, cold, culture, tradition, music, Bolivia, Christmas, Easter, soup kitchen, poverty, hungry, school, diet, illness, friends. The words were grouped into seven categories: culture, diet, home, poverty, religion, season and social event.

The analysis of proportion of elicited words by each category showed that Andean potato cake was associated ( $p < 0.05$ ) to their home (82.2%). Most of the participants clarified that they ate it at home but "made it with common potato". Cheese empanadas and Andean mashed potato were mainly associated with the culture (52.5% and 57.3% respectively,  $p < 0.05$ ). Pizza was associated to social events (70.1%,  $p < 0.05$ ). Oat soup, puchero, salpicón of chicken, salpicón of meat, salpicón of vegetables, noodle soup and vegetable soup were associated with home from 50.4% to 65.5% ( $p < 0.05$ ) of the grouping words. Moreover, the three types of soups, puchero and salpicón of vegetables were also recognized with poverty by a range of 15.6% to 31.9% of the respondents. Finally, oat soup and vegetable soup, and salpicón of chicken and of salpicón meat were identified with seasonal meals (from 13.1% to 33.1%,  $p < 0.05$ ), since consumers stated they eat soup in winter and salpicón in summer. The most unknown meals, verde potato stew with charqui (75.7%) and anchi of apple (48.4%) were significantly recognized as food of the gastronomic culture of the region. This region

**Table 4**

z-Values from the comparison of proportions between known/unknown and consumed/non-consumed meals.

Meal	Known/unknown z-Value	Consumed/non-consumed z-Value
Andean potato cake	11.8s	0.3ns
Mashed Andean potato	3.5s	8.6s
Salpicón of vegetables	13.9s	3.2s
Oat soup	7.5s	8.0s
Pizza	15.0s	7.5s
Puchero	14.4s	0.3ns
Salpicón of meat	13.6s	0.3ns
Noodle soup	13.9s	0.5ns
Cheese empanadas	13.1s	1.1ns
Verde potato stew with charqui	10.4s	14.2s
Salpicón of chicken	13.4s	2.7s
Vegetable soup	15.0s	3.2s
Anchi of lemon	11.8s	3.7s
Anchi of apple	2.7s	12.0s
Rice with milk	15.0s	3.5s
Fruit salad	15.0s	8.6s

$p < 0.05$ .

s: significant; ns: not significant.

encompasses the Northwest of Argentina, including the Salta and Jujuy Provinces, as well as Bolivia country. *Anchi* of lemon was identified with home (58.0%,  $p < 0.05$ ), fruit salad with home (31.7%) and religion (28.2%), and rice with milk with home (61.3%) and poverty (21.1%). Cheese *empanadas* were at lesser extent related to religion (16.4%) as a classic meal of Good Friday.

The results of the inertia decomposition of the correspondence analysis are shown in Table 6; one dimension represents 48.0% of the inertia, and two dimensions, 83.0%. Figure 1 shows the graphical representation of the correspondence analysis of the grouping words from the free association test. It shows the relation between the known, unknown, consumed, and non-consumed meals and the hedonic response in order to make more evident and visible the results. It can be seen that pizza was strongly related to a social event (mainly meeting with friends). Foods related to religion were fruit salad (mainly Christmas) and cheese *empanadas* (mainly Easter). They were known, consumed and fell in the category of “like extremely” meals (Fig. 1). On the other hand, *verde* potato stew with *charqui*, Andean mashed potato and *anchi* of apple were unknown, non-consumed and “dislike slightly/moderately” meals associated with Andean culture and Andean gastronomy. Rice with milk and *anchi* of lemon were known courses, related to home/poverty and grouped around “like slightly/moderately” meals.

Andean potato cake, *puchero*, *salpicón* of meat, chicken and vegetables, noodles and vegetable soups were known courses all iden-

tified with poverty, home and season (in general the *salpicón* with summer and the soups in winter). These foods fell between the “like very much” and “like moderately” area. Oat soup were known but not consumed and was related to poverty and seasonal meals. They were grouped around the “like slightly” meals.

Vegetable soup, *salpicón* of vegetables and *salpicón* of chicken were, in general, consumed by urban young people and also related to diet.

#### Relation between the nutritional composition and the acceptability of menus. Principal Component Analysis

The PCA of the correlation matrix for selected meals and macronutrients composition is shown in Fig. 2. The mean acceptability, total dietary fiber and energy were also included in this analysis. Micronutrients were omitted because it only makes sense to include macronutrients in connection with the different meals. Two principal components were significant in explaining the total variability of nutrients and acceptability measures. The results of calculations are given in Table 7. The first two principal components accounted for 82.0% of the total variance among the samples. As can be seen (Fig. 2), meals were separated from left to right along the PC1, according to carbohydrates and total dietary fiber on one hand, and energy, fat and protein on the other. Moreover, from up to down along PC2, meals were separated according to acceptability on one hand, and protein on the other (Fig. 2).

The results obtained in the Cluster Analysis are shown as a dendrogram in Fig. 3. Considering a distance of 2.6, four groups can be identified: cluster I which consisted of cheese *empanadas*, pizza and Andean potato cake; cluster II which included *salpicón* of meat, *salpicón* of chicken and oat soup; cluster III, which included rice with milk, *anchi* of apple, *anchi* of lemon, fruit salad, Andean mashed potato, *puchero*, noodle soup, vegetable soup and *salpicón* of vegetables. And finally, cluster IV which consisted of *verde* stew potato with *charqui*. The first cluster corresponds to meals associated to energy, fat and acceptability; the second cluster corresponds to meals related to energy, fat and protein; the third one, to samples characterized by carbohydrates content and total dietary fiber, and the fourth, to a food associated with total dietary fiber and protein opposed to acceptability (Fig. 2).

In general, the most accepted foods by urban young consumers were those with the least content of total dietary fiber and protein. In others words, the acceptability of meals was related to the content of energy, fat and carbohydrates, contrary to the content of protein and dietary fiber.

**Table 5**

Mean acceptability of Andean culinary preparations.

Group no. 1	Andean potato cake	Mashed Andean potato	Salpicón of vegetables	Oat soup
Mean	<b>7.86b</b>	<b>7.38b</b>	6.80a	6.83a
SD	<b>1.64</b>	<b>1.35</b>	1.48	1.50
Group no. 2	Pizza	Puchero	Salpicón of meat	Noodle soup
Mean	<b>7.97b</b>	7.05a	7.21a	6.80a
SD	<b>1.04</b>	1.75	1.38	1.32
Group no. 3	Cheese empanadas	Verde potato stew with charqui	Salpicón of chicken	Vegetables soup
Mean	<b>8.06c</b>	6.08a	<b>7.46b</b>	<b>7.04b</b>
SD	<b>0.96</b>	1.69	<b>1.15</b>	<b>1.44</b>
Group no. 4	Anchi of lemon	Anchi of apple	Rice with milk	Fruit salad
Mean	6.94a	6.91a	6.93a	<b>7.80b</b>
SD	1.49	1.43	1.54	<b>1.38</b>

Measured in hedonic scale: 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, 9 = like extremely.

Means within rows followed by different letters differed significantly at  $p < 0.05$  according to the Tukey's test.

**Table 6**  
Inertia decomposition of the correspondence analysis.

Dimension	Eigenvalue	Chi-square	Percent of inertia	Cumulative percent of inertia
1	0.70	5561.7	48.0	48.0
2	0.59	4038.5	35.0	83.0

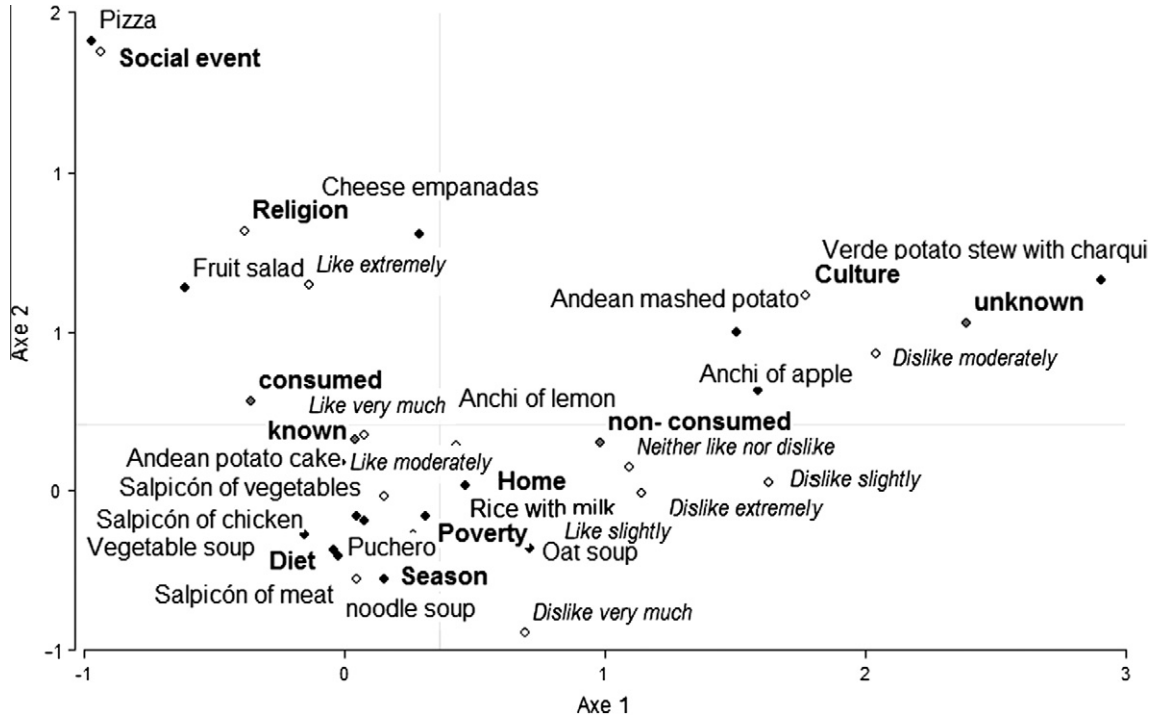


Fig. 1. Multiple Correspondence Analysis for each selected meals.

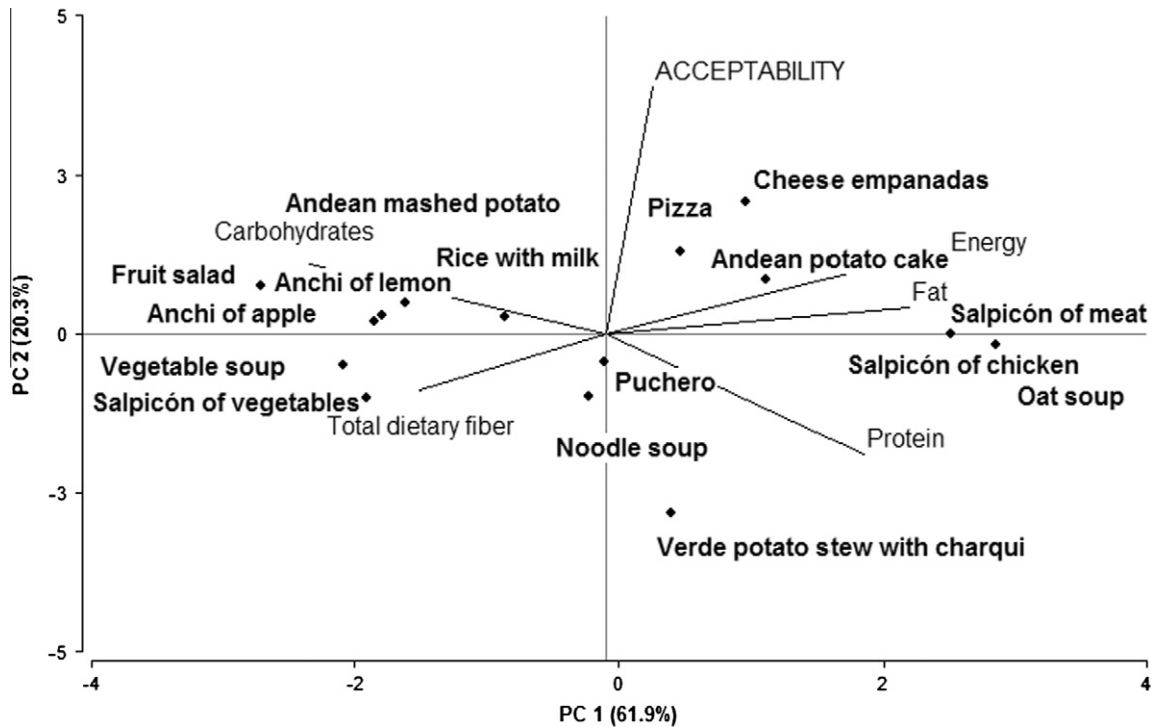


Fig. 2. Principal Component Analysis (PCA) of nutritional variables and acceptability of selected meals.

**Table 7**  
Eigenvalues, cumulative proportion and eigenvectors of PCA.

Variable	Eigenvalue	Cumulative proportion	Eigenvectors	
			e1	e2
Energy	3.72	0.61	0.48	0.24
Protein	1.22	0.82	0.42	-0.40
Fat	0.75	0.95	0.50	0.09
TD fiber	0.30	1.00	-0.31	-0.19
Carbohydrates	0.02	1.00	-0.49	0.23
Acceptability	0.01	1.00	0.08	0.83

## Discussion

### Most preferred menu of Punás children

The aim of this study was to investigate the acceptability of varied food menus accepted by children located at *Puna* and also in young urban people. The major observation obtained from their preferred menus was that the consumption of vegetables as a main course by this kind of children does not seem to be a problem given they like to eat soups and mixed vegetables (*salpicón*). Conversely, the gelatin which promotes less nutritious menus, is replacing the taste of the local and homemade desserts.

The quantity and the variety of fruits and vegetables drawn by children were in accordance with [Mozinet, Depezay, Masse, Combris, and Giboreau \(2011\)](#) who found that children from rural areas named significantly more vegetables. The most frequent ingredient was the Andean potato (in 17 of 20 menus) as the main staple food ([Devaux et al., 2009](#)). It is remarkable the difference this has with other studies ([Baik & Lee, 2009](#); [Contarini, Flores, & Hough, 2007](#); [Guenther, Dodd, Reedy, & Krebs-Smith, 2006](#); [Lorson, Melgar-Quinonez, & Taylor, 2009](#)) that affirm that the vegetable intake is too low and strategies are needed to encourage consumption ([Spill, Birch, Roe, & Rolls, 2011](#)). Surely, the limited access to food shops or cooking methods in the *Puna* is the reason of such difference. In fact, [Timperio et al. \(2008\)](#) analyzed the children's fruit and vegetable intake according to the neighborhood food environment and stated that children with at least one fast food outlet and one con-

venience store within 800 m of the home were less likely to consume fruits and vegetables than children who did not have these types of stores close to home.

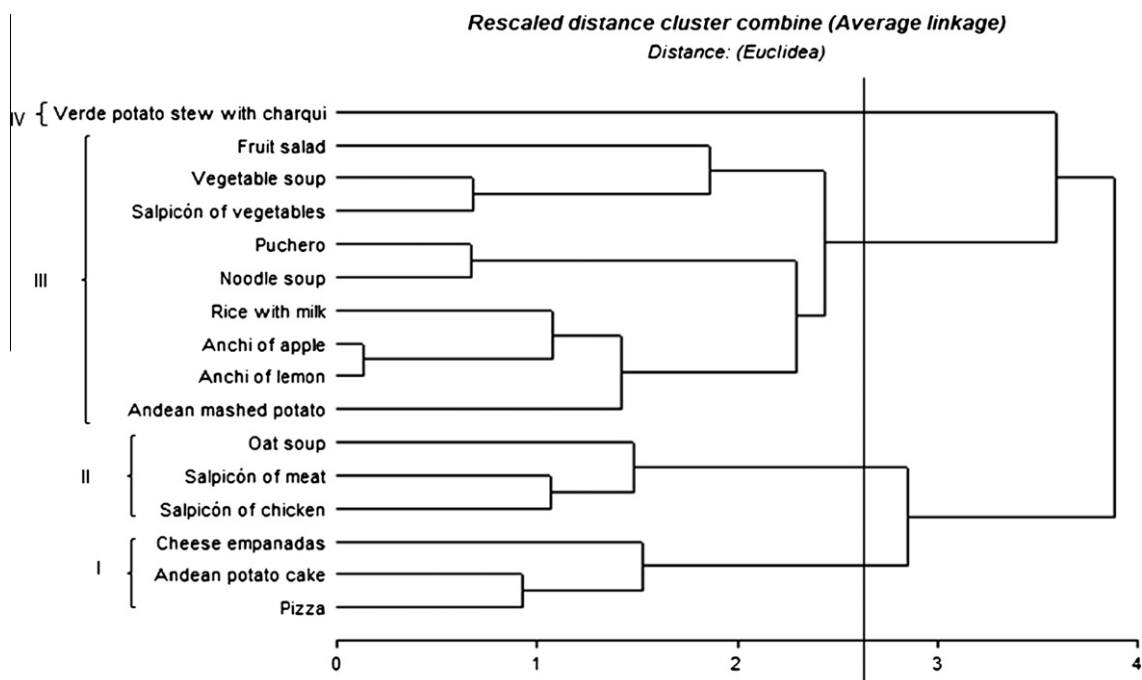
With respect to the desserts, the inverse tendency was observed: most children preferred gelatin instead of homemade desserts. This preference in children that attend institutional dining was also reported by [Contarini et al. \(2007\)](#) where it showed the replacement of native foods, which were more nutritious, by allochthonous foods which were less nutritious. In this case, the preference of gelatin – lacking of tryptophan – was also reported by [Santoni and Torres \(2002\)](#) and [Piu de Martin et al. \(2000–2001\)](#) in their anthropological studies. The lack of regular availability of industrialized desserts and the preference for sweetness in human beings at altitude ([Singh et al., 1997](#)) may be an important reason for this fact.

Several studies have been made concerning the quality of breakfast ([Condon, Crepinsek, & Fox, 2009](#)), the impact of breakfast consumption on health ([Gretchen, 1995](#)) and its nutritional status ([Nicklas, Myers, Reeger, Beech, & Berenson, 1998](#)). Also, there have been similar studies concerning the quality of lunch ([Condon et al., 2009](#); [Connors & Simpson, 2004](#)) and dinner ([Vejrup, Lien, Klepp, & Bere, 2008](#)). However, no publications were found concerning the study of the nutritional characteristics of the preferred menu of children. We considered it is a key issue to design feeding programs that children like to eat. In the present study, the combination of 51 ingredients resulted in 20 preferred menus.

*Puchero* and gelatin was the worst menu with respect to the percentage daily values showing a low input of six minerals and three vitamins. On the other hand, *asado* with salad and fruit salad was the food combination offering the most nutrients with maximum percentage. Moreover, some imbalances were detected when evaluating the caloric distribution. Further in depth research is needed considering the nutritional evaluation based on 3–4 days of diet registration.

### Most preferred menus of Punás children in urban people

Young urban people manifested that pizza was the most consumed meal supporting the affirmation that it is one of the most



**Fig. 3.** Dendrogram of the Cluster Analysis.



popular worldwide meals (Locci et al., 2008). Moreover, the preference and acceptability for its consumption has increased (Pacheco de Delahaye, Jiménez, & Pérez, 2005). These results are in agreement with others works which showed the increase of fast food consumption (Baik & Lee, 2009; Washi & Ageib, 2010). The difference is that in the *Puna*, all children said that the pizza is home-made while in urban areas it is bought from local stores, eaten at a pizzeria, or obtained through home delivery.

It is important to note that even though the Andean potato cake and cheese *empanadas* were not consumed by most of those polled (around 50%) these foods were liked very much. Also, even though the Andean mashed potato was not consumed by 78.6%, it was liked moderately (Table 5). These results indicate that consumers would accept them in their diet. In addition, the significant acceptability of *salpicón* of chicken, vegetable soup and fruit salad could be due that these foods were often consumed by respondents, since people generally prefer foods that they are familiar with (Mark, Lumbers, Eves, & Chang, 2012).

The acceptability of least consumed meals, Andean mashed potato, oat soup, rice with milk, *anchi* of apple and *anchi* of lemon placed moderately, where the Andean mashed potato showed the highest score (Table 5). Consumers said that they eat mashed potatoes made with the most common variety available in the market. The acceptability measured has surely been affected by the familiarity with the meal.

The acceptability of the least known meal – *verde* potato stew with *charqui* – shows it was liked slightly (Table 5). This suggests that it could be possible to incorporate it into urban peoples' diet, perhaps with a better combination of ingredients in order to improve its acceptability. The acceptability of foods may change over time through repeated exposure (Meiselman, de Graaf, & Leshner, 2000). The score obtained here may have been influenced by the novelty factor impact which considers that the acceptability obtained during the first exposure to a product can be up to 50% of the real (Köster, Couronne, Leon, Levy, & Marcelino, 2003). De Graaf et al. (2005) studied the relation between acceptability and food choice of main meals and snacks and stated that the likelihood of choosing a meal for the second time was positively related to the acceptability rating of the meal when it was consumed for the first time. In this study, meals were presented once.

Another factor that could influence the acceptability of meals is the environmental conditions. Premavalli, Wadikar, and Nanjappa (2009) studied the hedonic response of the same appetizers at three conditions: sea level, 11,500 ft. above sea level (approximately 3500 m) and laboratory, finding that acceptability decreases in the order of altitude > laboratory > base level. In the present study, the preferred menus were obtained from people that live in the *Puna* at 3500 m; and the hedonic test of them was made in laboratory conditions.

Regarding the soups, the acceptability of oat soup and noodle soup were between slight and moderately (between 6 and 7, Table 5) and vegetable soup was liked moderately. The better acceptability of vegetable soup in respect to others was also demonstrated by Michon, ÓSullivan, Sheehan, Delahunty, and Kerry (2010) who found that the soup type, which was the most consumed by participants between 20 and 70 years old, was with the flavor of mixed vegetables.

Free word association is a technique that was recently applied by several authors (Ares & Deliza, 2010; Guerrero et al., 2010) when evaluating meals or food products. In our work, consumers could elicit 43 different words from a total of 1344. This relatively low variety of words could be due to the fact that the stimulus was a concrete object instead of an abstract concept (Guerrero et al., 2010; Prabhu, 1987) which limits the variety of elicited words.

In the current study, soups were associated with poverty and home (mainly mother and family) but generally they are often seen

as a healthy food associated with dieting (Michon et al., 2010). This difference may be due to the middle class families who compose the majority of university populations (Jiménez & Margalef, 2010), and also to the influence of the mother in the food choice (Johnson, Sharkey, Dean, McIntosh, & Kubena, 2011).

Culture and religion are considered as major determinants affecting general food consumption and choice (Mark et al., 2012). This was reflected by the association of the cheese *empanadas* and fruit salad to Andean gastronomy or Andean culture and also by the association of the Andean mashed potato, *verde* potato stew with *charqui* and *anchi* of apple to religious dates like Good Friday, Easter or Christmas. In our work, foods associated with religion were consumed more than those associated with culture since urban Argentinians traditionally observe religious culinary customs.

Noticeably, the words “consumed”, “known”, and “diet” were closely located (Fig. 1) showing the relation with controlling food intake in trying to lose weight (Lowry et al., 2000) or for health reasons (Driskell, Meckna, & Scales, 2006).

#### *Relationship between the preferred menus of children, macronutrient composition and acceptability in urban people*

This is an important part of this work where the preferred menus, the macronutrient composition and the acceptability by urban people are integrated and deserves a special paragraph. The acceptability of meals was related to the content of energy, fat and carbohydrates, contrary to the content of protein and dietary fiber. This tendency was in line with Holm et al. (2008), who studied the acceptability of two types of diets, one with high protein content and the other with high carbohydrates. They found that, in spite of the high status of the first diet, it was no more acceptable due to cultural norms for meal formats and dietary composition.

On the other hand, a 2010 review by the National Heart Foundation of Australia affirmed that nutrition information labeling on menus enable consumers to choose healthier foods. It may also increase food sales if consumers see more value in foods for which they have more information. In the present work, nutrition information of menus was not available for consumers. More researches concerning consumer attitudes towards nutrition labeling on this menus would be interesting.

In summary, the consumption of vegetables as a main course by children (11–14 years) from the *Puna* was comfortable when it was consumed in the form of soups and mixed vegetables. On the contrary, the gelatin which promotes less nutritious menus, is replacing the taste for the local and homemade desserts. *Puchero* and gelatin was the worst menu with respect to the percentage daily values showing low input of six minerals and three vitamins. Also detected were some imbalances when evaluating the caloric distribution. On the other hand, *asado* with salad and fruit salad was the food combination that provided most nutrients. The government programs of food aid may take into account these results.

Secondly, because of the significant acceptability obtained by the cheese *empanadas*, Andean potato cake and Andean mashed potato, it could be affirmed that it is possible to incorporate them in the diet of the young urban population. What was least liked were the soups, *salpicón*, stew, *anchi* and rice with milk.

In third place, free word association tests reveal that the food that is most liked by the *Punás* children is represented in seven dimensions by urban consumers. The soups, *salpicón*, *puchero* and *anchi* were recognized as home, poverty or seasonal food; cheese *empanadas* and fruit salad as food of religious occasion; *verde* potato stew with *charqui*, Andean mashed potato and *anchi* of apple as food belonging to regional culture. The concept of diet was to a lesser extent associated with *salpicón* and vegetables soup

and *salpicón* of chicken. Finally, pizza was strongly related as the food of social events.

Lastly, because of their association with culture, the results suggest that the Andean mashed potato, as well as *verde* potato stew with *charqui* and *anchi* of apple, can be offered as traditional food. In this context, it could be taken into account that the acceptability of meals was mainly related to the highest content of carbohydrates, fat and energy, and the least content of total dietary fiber and protein.

The findings obtained in the present study will be a challenge for local economy concerning the area of gastronomic tourism and heritage and allowing contributions to the development and sustainability of rural areas.

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