African Food Tradition rEvisited by Research

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General approach

The work encompassed in this deliverable had as main objective the evaluation of sensory properties and European consumer acceptance of traditional African products from group 3 – plant based extracts for functional foods. The products selected for European studies at this stage were Bissap - *Hibiscus sabdariffa L.* and Baobab - *Adansonia digitata L.*. drinks. These results, besides the knowledge of European consumer perception about these products were also relevant to gather baseline information to support decisions concerning reengineering of the products.

AFTER project aims to revisit traditional African products, knowledge and know-how in the light of new technologies for the benefit of consumers, producers and processors in Africa and Europe. By applying European science and technology to African traditional food products, AFTER seeks to turn research into quantifiable and innovative technologies and products that are commercially viable in both European and African markets.

In order to efficiently assess the sensory properties and the European consumer preference and perception of the products the study was structured in the following steps:

I. **Bissap study:**
   a. Sensory evaluation and consumer preference studies involving the Portuguese consumer for Bissap
   b. Consumer preference study involving the English consumer for Bissap
   c. Consumer preference study involving the French consumer for Bissap

II. **Baobab study:**
   a. Sensory evaluation and consumer preference studies involving the Portuguese consumer for Baobab

I. Bissap study

The Bissap report consists of an introduction, materials and methods, results and conclusions. The introduction, materials and methods, are common in the three countries under review. The results will be presented separately by study and country. Finally, as conclusions it will be presented the overall findings of the study.

Introduction

Hibiscus sabdariffa L. is a herbaceous plant commonly known as Roselle that mainly grows in tropical and subtropical countries. The swollen calyxes, red color and cup-like, are the part of the plant of commercial interest (Mottram and Puckey 1978; De Castro and others 2004) as they are rich sources of vitamin C, phytochemicals, and are also used for making a variety of products including, infusions, food colorants, jam and particularly drinks (Gonzalez-Palomares et al. 2008; Sherif et al. 2011). Although there are different recipes, typically in Africa, the drink is made from an extract obtained by aqueous extraction from solid to solvent ratio, at temperatures between 25 and 100 ºC. After filtration, sugar and others ingredients may be added depending of the region where it is consumed (Cissan, 2010, Rodrigues et al, 2011). It is consumed as cold or hot beverage (Sáyago-Ayerdi et al, 2007, Rodrigues et al, 2011) and different aroma compounds were found according to the preparation (Rodrigues et al, 2011).

The consumption of this drink is widespread in Africa and Asia, and as far as we know little appears to have been published about European consumers' acceptance, once the drink is quite unknown in Europe. In order to achieve product acceptance followed by successful market introduction, it is prime importance to gain insight in the factors determining consumers' food choice. Understanding how consumers perceive food products is critical for food companies. This information is essential for the development and marketing of new products, the reformulation of existing ones, the optimization of manufacturing processes and the establishment of specifications in quality control programs (Meilgaard et al. 1999). As consumers are not always able to say why they like a product (Elmore et al. 1999), preference mapping techniques have been widely used to answer this question (Greenhoff and MacFie 1994; Schlich 1995; Murray and Delahunty 2000; Guinard et al. 2001; Van kleef et al. 2006). Preference mapping techniques try to correlate consumer preference ratings to perceived sensory characteristics of the product in order to determine how the sensory characteristics of the product affect consumer liking (Arditti 1997; Van kleef et al. 2006). Although preference mapping is one of the most popular tools of marketing research (Urban and Hauser 1993; Van kleef et al. 2006), it has been claimed to have several limitations (ten Kleij and Musters 2003; Krishnamurthy et al. 2007). One of these limitations is that it assumes that consumers and trained assessors perceive the products in the same way. Through these techniques, consumers are only asked how much they like the product, and therefore, information about how they perceive the sensory characteristics of the product is not gathered but in fact this information is directly related with consumer perception and preference of the product. Thus, sensory information is normally obtained from a trained panel (Faye et al. 2006). However, trained assessors could describe the product differently or take into account attributes that may be irrelevant for consumers (Kleij and Musters 2003). In order to gather information

about how consumers perceive the sensory characteristics of a food product, consumer studies usually include questions about the product's sensory characteristics (Meilgaard et al. 1999). Another alternative is the use of check-all-that-apply questions (CATA).

A CATA question consists of a list of words or phrases from which respondents should select all the words they consider appropriate to describe a product. The use of a CATA question resulted in a simple and valid approach to gather information about consumers' perception of the product, including both their sensory and hedonic impression. Considering results from the present study, the use of CATA questions could be an interesting methodology to obtain a sensory map based only on consumer perception of the products and to perform external preference mapping when a sensory trained panel is not available.

The aim of the consumer studies was gathering information based on a structured focus group and on a QDA performed in Portugal, to apply afterwards Check-All-That-Apply (CATA) questions to compare consumer perception in the development of *Hibiscus sabdariffa L.* drink products between European countries, namely Portugal, United Kingdom and France. Four samples (n=4) were tested, two directly as commercial products - viz. 1 commercial syrup and 1 commercial instant drink and two produced in place from calices according traditional processes. Consumer's studies were performed in Oporto, Porto - Portugal, with 100 people from two Portuguese Catholic University Campuses, in Chatham, United Kingdom, with 120 people from the University of Greenwich and in Montpellier, France with 120 people from two canteens at the CIRAD Campus (La Recherche Agronomique pour le Développment) viz. – Baillarguet and Lavallete. Consumers were asked to score their overall liking and to answer a CATA questionnaire that included 28 sensory and hedonic terms.

The sensory evaluation of the traditional African products was performed only in Portugal by a trained assessors' panel. Sensory profiles of selected drinks were determined using a trained panel and an established sensory language. Six traditional samples (n=6) brought from Senegal were tested, two directly as commercial products - viz. 1 commercial syrup and 1 commercial instant drink and four produced according to traditional approaches from calices. Principal Component Analysis (PCA) was used based on Qualitative Descriptive Analysis (QDA) results. Sensory lexicon was generated during preliminary focus group sessions guided by a panel leader. To gather information on perceptions and attitudes of consumers towards Bissap drink, a qualitative study by using focus groups to collect data was performed intending to probe and develop knowledge on the following issues: i) most valued attributes of this drink and respective levels; ii) possible consumption situations and usage for this type of new drink. This data was analysed by conjoint analysis methods aiming to: iii) measure the important attributes for consumers and iv) determine possible different and relevant market segments for this product in Portugal.

Material and Methods

Samples

The Bissap samples were from three different types: Ordinary calyces or Koor variety from Senegal and Vimto variety originated from Sudanese, and syrup from Esteval, a Senegalese company and instantaneous powder "Starling" commercialized by Racine SA, France.

Traditional samples were prepared using local traditional practices under good safety conditions. Calyces were extracted in water at room temperature (typically 2 hours) (5% (m/v)) or boiled (typically 1 hour) (3,3% (m/v)). Sugar (130 g/L) was added after filtration followed by pasteurization at T=85ºC for 20 minutes.

The syrup drink was prepared by dilution (1:4) of the commercial syrup (made with calyces infusions concentrated).

The instant drink was prepared after dissolving the granules in water, 10 % (m/v), at room temperature.

Six different samples (traditional and commercial) were presented to the panellists as the following:
1. Traditional ambient temperature Vimto infusion
2. Traditional boiled Vimto infusion
3. Traditional ambient temperature Koor infusion
4. Traditional boiled Koor infusion
5. Commercial syrup diluted 1:4
6. Commercial instant drink

Ethical assessment and consent

This study has been assessed and approved by the NRI Ethics Committee. Consent was signed by sensory panellists and consumers which participated in this study. Interviewers informed participants about the study and explained that their participation was entirely voluntary, that they could stop the interview at any point/time and that the responses would be anonymous.

Sensory evaluation

The Bissap samples were evaluated and scored by a trained sensory panel (as described on ISO 11035:1994 Sensory analysis — Identification and selection of descriptors for establishing a sensory profile by a multidimensional approach - Standard Operation Procedure 2 (SOP 2)), according Figure 1.
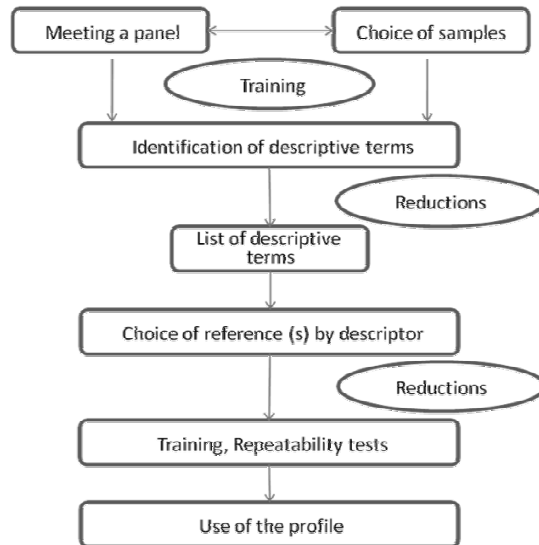
Figure 1 - Sensory profile methodology.

The panel was composed by university employees and students (n=7) previously selected according their sensory ability and familiarity with drinks (they had been trained for this type of products, during previous sessions). Sessions were conducted at sensory rooms with controlled room/air temperature and lightning. The language used for the sensory testing was Portuguese and English.

Sensory attributes were generated during preliminary focus group sessions guided by a panel leader. A total of 20 sensory attributes were developed, with correspondent references/or anchors, with panel consensus, as represented in Table 1 and Table 2, respectively.

Table 1 - Bissap "Hibiscus" Drink - Attributes definition.

Bissap *"Hibiscus"* Drink - Attributes definition

ATTRIBUTES	DEFINITION
APPEARANCE	
COLOR INTENSITY	intensity or strength of the color from light to dark (weak to strong)
VISCOSITY	in everyday terms (and for fluids only), viscosity is "thickness". Thus, water is "thin", having a lower viscosity, while honey is "thick", having a higher viscosity.
ODOUR EVALUATION	
ODOUR/SMELL	
FLORAL floral - *Hibiscus* flower	general term for a product with aroma or flavor reminiscent of flowers. May be very pleasant.
FRUITY raspberry	overall description for a product in which fruitiness is the predominant aroma or flavor.
HERBACEOUS hay	herbaceous: General term (see also "vegetal") for a product with "green," "grassy" or "hay-like" aroma or flavor. green: the aromatic associated with unprocessed vegetation, such as fruits and grains; this term is related to raw, but has the additional character of hexenals, leaves, and grass.
OTHERS	
cold black tea	aroma associated with tea of poor taste which indicates old tea or tea that is not fresh.
raisins	aromatic associated with a grape of any of several varieties that has been dried in the sun or by artificial heat.
honey	aroma or flavor associated with a sweet viscid material elaborated out of the nectar of flowers in the honey sac of various bees.
TASTE EVALUATION	
TEXTURE IN MOUTH	
viscosity	in everyday terms (and for fluids only), viscosity is "thickness". Thus, water is "thin", having a lower viscosity, while honey is "thick", having a higher viscosity.
FLAVOUR	
acid	the taste stimulated by acids, such as citric, malic, phosphoric, etc.
sweet	the taste stimulated by sucrose and other sugars, such as fructose, glucose, etc.
bitter	the taste stimulated by substances such as quinine, caffeine, and hop bitters.
TASTE	
FLORAL floral - *Hibiscus* flower	general term for a product with aroma or flavor reminiscent of flowers. May be very pleasant.
FRUITY raspberry sour cherry	overall description for a product in which fruitiness is the predominant aroma or flavor.
HERBACEOUS hay	herbaceous: General term (see also "vegetal") for a product with "green," "grassy" or "hay-like" aroma or flavor. green: the aromatic associated with unprocessed vegetation, such as fruits and grains; this term is related to raw, but has the additional character of hexenals, leaves, and grass.
TASTE EVALUATION	
OTHERS	
cold black tea	aroma associated with tea of poor taste which indicates old tea or tea that is not fresh.
raisins	aromatic associated with a grape of any of several varieties that has been dried in the sun or by artificial heat.
honey	aroma or flavor associated with a sweet viscid material elaborated out of the nectar of flowers in the honey sac of various bees.
OTHERS SENSATIONS	
adstringent	the shrinking or puckering of the tongue surface caused by substances such as tannins.

Table 2 - Bissap "Hibiscus" Drink -References/Anchors.

	REFERENCES/ANCHORS	
APPEARANCE		
COLOR INTENSITY (1-weak, 5-strong)	1 - Bissap tea	5 - sample 3 hot extraction
VISCOSITY (1-low, 5-high)	1 - water	5 - pure syrup
ODOUR EVALUATION		
ODOUR/SMELL		
FLORAL		
floral - *Hibiscus* flower (0-absent, 5-strong)	0 - water	4 - pure syrup
FRUITY		
raspberry (0-absent, 5-strong)	0 - water	5 - dried podwer (instantaneous) or raspberry
HERBACEOUS		
hay (0-absent, 5-strong)	0 - water	5 - air-dried vegetation, hay
OTHERS		
cold black tea (0-absent, 5-strong)	0 - water	5 - black tea infusion (brand, amount, time and
raisins (0-absent, 5-strong)	0 - water	5 - raisins (brand, grape variety)
honey (0-absent, 5-strong)	0 - water	5 - honey (brand, variety)
TASTE EVALUATION		
TEXTURE IN MOUTH		
viscosity (1-low, 5-high)	1 - water	5 - pure syrup
FLAVOUR		
acid (0-absent, 5-strong)	0 - water	4 - sample 3 hot extraction
sweet (0-absent, 5-strong)	0 - water	5 - syrup diluted at 25% (1:3)
bitter (0-absent, 5-strong)	0 - water	4 - sample 3 hot extraction without sugar
TASTE		
FLORAL		
floral - *Hibiscus* flower (0-absent, 5-strong)	0 - water	4 - pure syrup
FRUITY		
raspberry (0-absent, 5-strong)	0 - water	5 - raspberry jelly (brand)
sour cherry (0-absent, 5-strong)	0 - water	5 - sour cherry jelly (brand)
HERBACEOUS		
hay (0-absent, 5-strong)	0 - water	5 - air-dried vegetation, hay
OTHERS		
cold black tea (0-absent, 5-strong)	0 - water	5 - black tea infusion (brand, amount, time and Temperature) prepared 24 hous before
raisins (0-absent, 5-strong)	0 - water	5 - raisins (brand, grape variety)
honey (0-absent, 5-strong)	0 - water	5 - honey (brand, variety)
OTHERS SENSATIONS		
adstringent (0-absent, 5-strong)	0 - water	5 - black tea infusion (brand, amount, time and Temperature) prepared 24 hous before

During consecutive training sessions, the panel was exposed to different Bissap samples and tried to identify all (or part of) the aforementioned attributes. Subsequently, the panel was presented with selected samples of Bissap and based on the list, they had to identify and quantify the main descriptors using a 0 to 5 continuous scale (100 mm) – in which 0 stands for none and 5 for strong. At each session, six samples labelled with three digit random numbers and served in transparent plastic cups (50 mL), were present at each panellist monadically according to a balanced design. Mineral water was available for rinsing between samples.

Consumer study - Focus group

In order to have some knowledge about the perceptions of consumers on Bissap drink an explorative methodology was first used. The instrument for data collection was Focus Groups, conducting according to standard procedures (Morgan, 1997) using the script for the purpose mentioned above, and a video recorder. The themes exploited in Focus Groups are presented in Table 3.

Table 3 – Topics of Focus Groups Guide

Exploited Topics of Focus Groups
A. Global sensory characterization of each sample
Taste of four blind Bissap drink samples:
sample A – Cold Extraction
sample B – Instantaneous
sample C – Hot Extraction
sample D – Syrup
B. Attitude to buy
C. Occasion of consumption
D. Motives of consumption
E. Willingness to pay
F. Local to buy
G. Others possible applications of Bissap
H. Influence of African Origin on labelling

A pilot focus group was implemented to test the discussion guide and then three focus groups (90-100 min) were performed between November and December (2011) with 22 recruited volunteers. The characterization of participants can be seen in Table 4.

Table 4 – Sociodemographic profile of focus groups participants

Demographics	Participants (%)
Male	46%
Female	54%
Age 18-25	36%
Age 26-55	36%
Age + 55	27%
Single	41%
Married	59%
Higher degree education	55%
Secondary degree education	45%
Socio-Economical Status (ESOMAR guidelines): A	14%
Socio-Economical Status (ESOMAR guidelines): B	36%
Socio-Economical Status (ESOMAR guidelines): C1	23%
Socio-Economical Status (ESOMAR guidelines): C2	23%
Socio-Economical Status (ESOMAR guidelines):E2	5%

Fruit juice consumers (requirement of recruitment)	100%
Responsible for buying food stuffs(requirement of recruitment)	100%

The focus groups were recorded in DVD and all data produced were afterwards transcript verbatim to text, and analysed by using content analysis techniques in software NVivo, to outline findings and meet research goals for this stage.

Conjoint Analysis

Conjoint Analysis is a powerful tool to assist marketing researchers in modelling human decision making, once it quantifies the importance that people give to various attributes that underlie decisions, predicting which products (or services) people will prefer, and it reveals whether the market is sensitive or indifferent to the various features of a product (Austin, 2000).

How consumers evaluate their choices is affected by a complex set of factors that influence and shape decision process behaviour, including individual differences and environmental influences (Blackwell, 2006). As a result, evaluative criteria become product-specific manifestation of an individual or group needs, values, and so on. Conjoint analysis is well suited for the implementation of selected types of market segmentation (Green, 1991). These results allow to develop benefit-based segments to identify distinct groups consumers, such as those seeking products on the basis of price or others specific attributes (Austin, 2000).

This methodology has been widely used in food research and its efficacy and usefulness is clearly proved in order to achieve consumer's preferences. A large number of conjoint analysis studies with different food products are published, eg: pineapple juice (Finco, 2010), functional foods (Grunert, 2003; Larson, 2003), wines (Gil, 1997, Quester, 1998), olives (Moskowitz, 2005), impact of reduced salt content (Hersleth, 2011), foods processed (Cardello, 2007), food bars (Mahanna, 2009),

Because acceptability factors depend of the importance of each attribute conjoint analysis was selected as best approach. The attributes and levels were defined according with the focus groups results and market research.

The attributes generated by focus groups were also useful to be used in further sensorial research, specifically to develop CATA (Check-All-That-Apply) questionnaires.

Table 5 – Attributes and operationalization of the conjoint study

Attributes	Number of level	Description of levels
1 – Price / L	4	a) 0,99€ b) 1.49€ c) 1.99€ d) 2.49€
2 – Colour of the drink	2	a) Transparent red (like rosé wine) b) Dark red (like red wine)
3 – Calories	4	a) Light (less than 18 Kcal / 100 ml) b) Low calories (between 18 e 32 Kcal / 100 ml)

		c)	Slightly Caloric (between 32 e 45 Kcal / 100 ml)
		d)	Caloric (more than 45 Kcal /100 ml)
4 - Package information about antioxidants	2	a)	With antioxidant information
		b)	Without antioxidant information
5 - Material Package	4	a)	Tetra-Pack
		b)	Glass
		c)	Can
		d)	Plastic
6 - Package Bissap Information	2	a)	Made with Bissap Flower
		b)	Without reference to Bissap flower
7 - Package information about origin	2	a)	African origin
		b)	No information about the product origin

By using an orthogonal plan created by conjoint model of SPSS (version 19), thirty seven full-profile Bissap drink were produced. It was developed a questionnaire in which respondents have to evaluate the probability of buy each one of the presented profiles, by using a liker 5 points scales (1- certainly would not buy to 5 – certainly would by).

As the market segmentation presupposes heterogeneity in buyers 'preferences and ultimately choices for products, and as it can be related to person variables (Green, 1991), the questionnaire also includes socio-demographic information about participants: age, gender, educational level, socioeconomic level, job classification and frequency of juices/non-alcoholic drinks consumption.

A convenience sample of 107 responses was used in order to have reliable results.

Consumer study – CATA test

Participants were recruited considering their interest and availability to participate in the study. At recruitment stage, no information about the specific aim of the study was provided. Consumer's studies were performed in Oporto, Porto - Portugal, with 100 people from two Portuguese Catholic University Campuses, in Chatham, United Kingdom, with 120 people from the University of Greenwich and in Montpellier, France with 120 people from two canteens at the CIRAD Campus (La Recherche Agronomique pour le Développment) viz. − Baillarguet and Lavallete. Consumers were asked to score their overall liking and to answer a CATA questionnaire that included 28 sensory and hedonic terms. Consumers were interviewed using the central location method (Meilgaard et al., 2007).

Figure 2 - Consumer study apparatus: Portugal, United Kingdom, France, respectively.

Four Bissap drinks were selected for consumer tasting among the samples used for sensory analysis, namely:

1. Traditional ambient temperature Vimto infusion
2. Traditional boiled Vimto infusion
3. Commercial syrup diluted 1:4
4. Commercial instant drink

Figure 3 - Bissap samples for consumer study.

The samples were selected since they were the most different among the available traditional drinks.

Consumers were asked to score their overall liking, concerning appearance, smell, taste and global appreciation, of each sample on a 9-point hedonic scale (1 = "dislike extremely, 9 = "like extremely"); sweetness of each product using the 9-point "Just About Right" (JAR scale) (1 = "Extremely less sweet than ideal", 9 = "Extremely more sweet than ideal") and their willingness to buy on a 5-point scale (1 = "certainly would not buy", 5 = "Certainly would buy"); and to answer a Check-All-That-Apply (CATA) questionnaire that included 28 sensory and emotional terms.

Consumers were asked to check all the terms they considered appropriate to describe each samples. The terms were selected based on previous studies (sensory evaluation and focus-group performed by Portuguese Catholic University), published data and marketing campaigns of Bissap in African market.

As shown in Table 6, the terms considered in the CATA questionnaire were grouped into two categories: sensory characteristics (n=16) and perceptions (n=12).

Table 6 - List of attributes considered in CATA study.

SAMPLE				
APPEARANCE				
Red Colour				
Pink Colour				
Clear				
Viscous				
Fluid				
SMELL AND TASTE				
Flowers				
Fruity				
Fresh herb				
Cold Black Tea				
Raisins				
Honey				
Acid/Sour				
Sweet				
Bitter				
Harsh taste				
Hay				
PERCEPTIONS				
Natural				
Artificial				
Smooth				
Full Bodied				
Astringent (makes mouth dry)				
Healthy				
Fresh				
Like an Instant Drink				
Watery				
Strong				
Diluted				
Concentrated				

Data analysis

An analysis of variance (ANOVA) was performed on consumer overall liking scores considering assessor and sample as fixed source of variation. Mean ratings and honestly significant differences were calculated using Tukey's test, and were considered significant when p ≤0.05.

A principal component analysis (PCA) was also performed on the correlation matrix of the means of the trained assessors' data.

All data produced of focus groups were afterwards transcript verbatim to text, and analysed by using content analysis techniques.

In order to identify groups of consumers with similar preference patterns, a hierarchical cluster analysis was performed on overall liking data. Euclidean distances and Ward's aggregation method were considered.

For the CATA study, frequencies of mention for each word were determined by counting the number of consumers that used that word to describe each Bissap drink, and Cochran's Q test was carried out for each of the 28 terms, considering sample and consumer as sources of variation to evaluate if the CATA question was able to detect differences in consumers' perception of the evaluated samples. Cochran's Q test is a nonparametric statistical test, which is used in the analysis of two-way randomized block designs to check whether k treatments have identical effects, when the response variable is binary.

A multiple factor analysis (MFA) was performed on responses to the CATA question in order to identify relationships between the terms and the samples and to get a sensory map of the samples (Bécue-Bertaut and Pagès 2008). This analysis was performed on the frequency table that contained responses for each category of terms of the CATA question, considering consumer overall liking scores as supplementary variable. In this analysis, the different categories of terms from the CATA question were considered as separate groups of data to investigate the relationship between them.

Finally, external preference mapping was used to link consumer overall liking scores and responses to the CATA question. A density plot of consumer liking was created, identifying the percentage of consumers satisfied with samples. In this plot, the points of maximum density were considered as corresponding to the ideal products.

All statistical analyses were performed using software NVivo, SPSS 19 and XLSTAT 2012.

Results –

I. Bissap study

a) Sensory evaluation and consumer preference studies involving the Portuguese consumer for Bissap

Sensory evaluation

Qualitative Descriptive Analysis (QDA) was performed in order to establish a sensory profile of Bissap drinks (Figure 4). Highly significant differences (P<0,001) between the samples were found for all the evaluated sensory attributes.
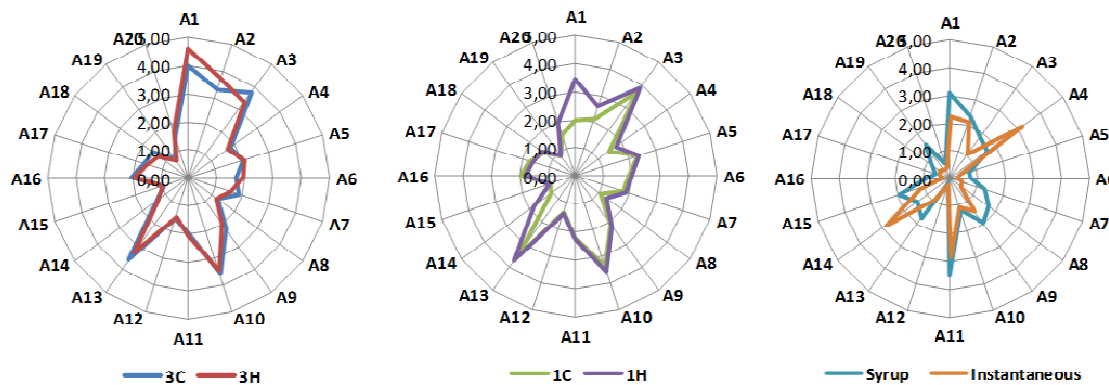

Figure 4 - Sensory profile (QDA) of Traditional ambient temperature Vimto infusion (3C) and Traditional boiled Vimto infusion (3H); Traditional ambient temperature Koor infusion (1C) and Traditional boiled Koor infusion (1H); Commercial syrup diluted 1:4 (Syrup) and Commercial instant drink (Instantaneous).

In what concerns Traditional infusions, samples are characterized by their strong colour intensity, high viscosity, floral and acid attributes. Sample 3H differs from 3C only in colour intensity (3H is higher than 3C) and in viscosity (3C is higher than 3H). Sample 1H differs from 1C only in colour intensity and viscosity attributes (1H has higher scores than 1C).
Syrup sample is represented by their strong colour intensity and high viscosity, sweet, floral and sour cherry attributes. Instant drink is real distinguished between samples by their high intensities of raspberry and sweet attributes.
Sensory profiles of samples 3Q, 3F, 1Q and 1F are more complex then sensory profiles of Syrup and Instant drink samples.
Principal component analysis (PCA) was performed to summarize the relationship between the sensory attributes and the Bissap drinks (Traditional ambient temperature Vimto infusion (3C), Traditional boiled Vimto infusion (3H), Commercial syrup diluted 1:4 (Syrup) and Commercial instant drink (Instantaneous). The first two principal components (PCs) accounted for by 76,95 % and 21,20 % of the variance of the experimental data, respectively. As shown in Figure 5, the first PC was positively correlated to floral, hay, cold black tea, raisins, bitter, acid and adstringent sensory attributes. Therefore, this PC was mainly related to Traditional ambient temperature Vimto infusion (3C) and Traditional boiled Vimto infusion (3H) samples. On the other hand, the second PC was related to sweet and sour cherry

sensory attributes being associated with Commercial syrup diluted 1:4 sample and raspeberry attribute with Commercial instant drink sample.
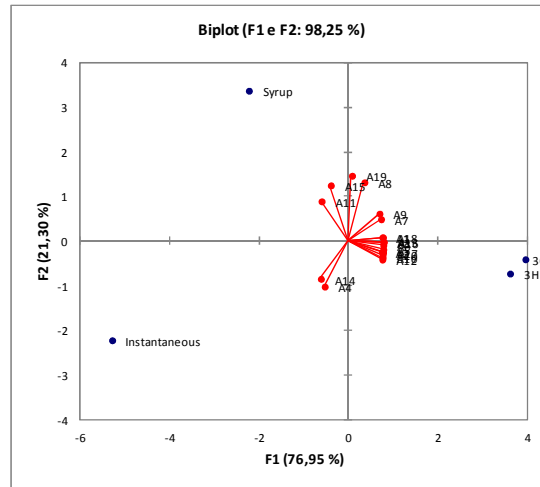
Figure 5 - Principal Component Analysis of trained assessor's sensory data (representation of sensory attributes and Bissap samples).

Focus Groups

1. Global Characterization of Bissap Drink

From all samples presented the most appreciated one was sample B, followed by sample C, sample D, and the less appreciated was the sample A. Briefly is presented a characterization of each sample based on the speech of the participants:

Sample A (cold extraction) – Related with winter; very sweet taste; strong taste and negative aroma; dark and artificial colour; very acid in the end after taste.

Sample B (instantaneous) – Related with summer; equilibrated taste; watery; negative colour; taste associated to pomegranate; good taste but bad appearance.

Sample C (hot extraction) – Taste similar with A sample, very sweet and acid in the aftertaste; negative aroma; good colour; it was identified hibiscus.

Sample D (syrup) – Very sweet. Taste similar with sample C. Reasonable colour.

As it is presented in Table 7, regarding to the description of attributes two groups were generated according to the positive and negative opinion of participants.

Table 7 – Frequency of principle attributes generated during the Focus Groups

Attributes	Frequency of responses
Sensory	
Sweetness	64%

Astringency	32%
Acid	32%
Watery	23%
Bitter	23%
Food Related Positive	
Pomegranate	100%
Fruity	23%
Cranberry / Blackberry	18%
Hibiscus	14%
Blackcurrant	14%
Tomato	9%
Cherry	9%
Sour Cherry	5%
Food Related Negative	
Wine	9%
Non-Food Related Negative	
Syrup/Medication	18%
Poison	5%
Plastic	5%

2. Attitude to Buy

In this item it was evaluated the frequency of consumption if this beverage was available on the market. The results show that almost half participants (46%) seem predisposed to buy the Bissap drink between 2/3 times a week; 36% between 1/2 in a month; 9% would buy it in a sporadic way; 5% once a week and 5% would not buy it.

3. Occasion and Local for consumption

The Table 8 below is a resume of the main occasions and locals for Bissap Drink consumption for Portuguese consumers.

Table 8 – Identified occasion and locals for Bissap drink consumption

Occasion for consumption	Frequency (%)
Breakfast	50%
Lunch	41%
Middle of afternoon	64%
Dinner	32%
Locals forConsumption	
Home	95%
Terrace	50%
Café/bar	50%
Macrobiotic Restaurant	41%
SPA	27%
Gymnasium	23%
Hotels	14%

4. Motives for consumption

Healthy reasons were the main reason presented for bissap drink consumption by Portuguese consumers. This motive is mostly presented by women's (75%) contrasting with sensory properties which man's valuated more (90%). Nevertheless, novelty is an important factor for both genders (50% each one). Participants knew in advanced that this drink have in their composition a high level of antioxidants and as these components might be important for our health, so they would be willing to consume it even if the taste is not so pleasant they expected. This result is in line with the results of Sparke and Menrad (2009), where health is also identified as one of the motives for functional drinks consumption. Nevertheless, taste/sensory properties and perceived health benefits are two important considerations for food acceptance and it has been discussed in functional foods context by some authors. According to Verbeke (2007) consumers in general are hardly willing to compromise on the taste of functional foods for health. Sabbe and others (2009) concluded that for Belgium consumer´s acceptance and intention to purchase açaí fruit drinks is driven most by their sensory pleasure and less by the health benefits.
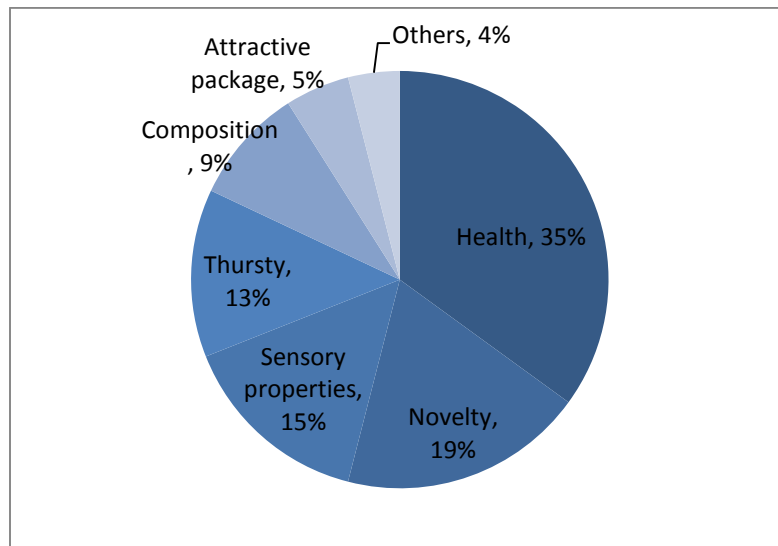
Figure 6 - Reasons for bissap drink consumption by Portuguese

5. Willingness to pay

Regarding willingness to pay for Bissap Drink, about 60% of participants imagine themselves buying 1 L packages in supermarkets. The range price varies between 0,70€-2€ / L, although the most part of them are between 1,5€-2€ / L.

Moreover, the others 40% imagine themselves buying small packages of 0,33cl in one of these specific locals: supermarkets or cafés/bars. In this cases the price varies between 0,35–0,50€.

Package has an obviously impact on product price. Consequently participants talked spontaneously about their preferences of package material: 14% prefers glass bottles for this drink rather the most part of them prefers tetra-pack. Cans were referred as not applicable for this type of drink.

Some participants also referred that would be available to pay more than the value appointed if i) the package would be very attractive ii) the package contain relevant information about the product; and iii) if this drink really have high level of antioxidants and consequently health benefits.

6. Locals to Buy

Consists on locals where consumers would like to buy Bissap drink, almost all (82%) would like to have this drink available in supermarkets (82%), also cafés (27%), bares (23%) and restaurants (9%) were mentioned. In addition convenience shops, pharmacy and gas pump shops where also referred each one representing 5% of frequency.

7. Possible applications

The Table 9 below resume the applications proposed by the participants and the frequency as well. The suggestions presented were grouped in two distinct groups according the type of application.

Table 9 – Possible application product type of Bissap

Applications Type	Product Suggestion	Frequency
	Yogurt	27%
	Gelatine	23%
Agro-Industries	Ice-creams	18%
	To mix with non-alcoholic drinks	14%
	To make Sangria	5%
	Topping/Dressing	50%
House maid	Jelly	41%
	Sauce	5%

8. Influence of the origin

Concerning the importance and influence to consumers' choice of drinks origin´s in labelling, it is verified that consumers can be grouped in two different clusters: i) for some participants (9%, mans, age between 18-25) labels and their information is not at all important, they do not read or look it, so for them do not really matter if it says or not the origin of the product; ii) for the others participants (81%) a general agreement exists about the importance in having this information in packaging labelling. One of reasons presented to justify is because consumer like to be informed about the product, knowing their origin for example, or even some background about that; another reason referred is because Africa has a less intensive agriculture not abusing on pesticides and some consumers can connect this fact to a healthy agricultural products, which means that this information can add value to products. Additionally, it was also said that as Africa is much related with solidarity campaigns, it could be also an advantage to include in labelling the origin of the drink, in order to influence the consumer´s choice. Nevertheless, for these participants it is clear that they would not be influenced by that information on their choices.

Conjoint Analysis

From the evaluation given by the respondents to the hypothetical product and applying the Conjoint Module of Statistical software package SPSS 19, we estimate the part-worths of

each of the product attributes as an aggregate for all the consumers. The results are presented in the next Table.

Table 10 – Part-worth of levels and relative importance of attributes

Attribute	Level	Part-worth	Relative importance (%)
Origin Information	African Origin	-,017	5,088
	Without information about African origin	,017	
Drink Color	Red dark color (type red wine)	-,004	5,877
	Light red color (type rose wine)	,004	
Bissap Information	Made with Bissap Flower	,052	6,465
	Without information about Bissap	-,052	
Antioxidant Information	With Antioxidants	,036	6,726
	Without antioxidants information	-,036	
Calories	Light (less than 18 Kcal/ 100ml)	,166	25,675
	Slighly Caloric (19-33 Kcal/100ml)	,159	
	Moderatly Caloric (34-44 Kcal/100ml)	-,074	
	Caloric (more than 45 Kcal/100ml)	-,251	
Package	Can	-,075	23,979
	Glass	,050	
	Plastic	-,091	
	Tetra-pack	,116	
Price	0.99€ / L	-,278	26,190
	1.49€ / L	-,556	
	1.99€ / L	-,834	
	2.49€ / L	-1,112	

The most salient attribute for these Portuguese consumers related to Bissap drink is the Price, which had the highest relative importance (26,2%). This is not so surprising results because the price is much related with food choice and purchase. Also in others studies developed with this methodology the price has been the first attribute most valued by consumers for different products (Finco, 2010, Mesías, 2010) and identified as one of the main factors for non-consumers not buy functional drink (Sparke and Menrad, 2009). It is interesting to note that there is an inverse relation between price and part-worth, as higher the price is the lowest the part-worth. Consumers were also significantly affected by the "calories", and the relative importance for this feature reached 25,7%. In this case the lowest nutritional value is somehow health related, especially to weight loss. Again an inverse relation is notice between the part-worths and the calories value. With similar importance appears afterwards the "package", in terms of material package, with a relative importance of 23,9%. It is interesting to notice that for this group of consumers the package information is not so important as the antioxidant information, bissap information or either the reference to the African origin of the product. This was also verified with Sparke and Menard (2009) for a functional orange drink: the packaging holds a relative importance higher than the health claims. A possible explanation for this is given by Larsen (2003) where he indicates that the perception of the healthiness of functional foods is more dependent on their perception of the nutritional qualities of the based-product than on any type of health claim. All the others evaluated attributes doesn´t seem to be crucial for purchasing intention once their relative importance's are between 5% and 6%.

The preferred bissap drink would be which, from each combination of attributes, offers respondents the great utility. In this case the ideal product corresponds to Bissap drink at a price of 0.99€/L, Light (less than 18 Kcal/100ml), Tetra-pack package, with antioxidants information on package, with Bissap information on package, light red colour drink. This group of consumers did not valorise the information about African origin of the beverage.

In some way it seems contradictory that the African origin information expressed in the package is the attribute with the lowest relative importance for Portuguese consumers. According to the perception from the focus groups this attribute was classified as very important for consumers, adding value to the product, and making some the difference when purchasing. But when we go further and it is evaluated in a group of attributes, and consumers are forced to choice a profile product, the result it is not anymore a priority for consumers.

1. **Reliability**

From the evaluation of the respondents to the hypothetical products, and applying the "Conjoint" module of statistical software package SPSS 19, the part-worths of each of the product´s attributes were estimated. Consistency of participant´s response, which means if the model fit individual data, can be evaluated by calculating the Pearson correlation coefficient (R) between the original ratings given by respondents and those determined by the model (Malhotra, 1996). The resulting value (R = 0,962) indicated that the model predicted the consumer´s preferences well. Also the Kendall´s tau for Holdouts coefficient, which is an

indicator of internal validity, has a higher value of 0.738 for a significance of 0.038, which indicates a good predictive ability.

Table 11 – Correlations between observed and estimated preferences

	Value	Sig.
Pearson's R	,962	,000
Kendall's tau	,857	,000
Kendall's tau for Holdouts	,738	,038

2. Consumers performance segmentation

The market segmentation is the process of finding groups of costumers who are similar on some specific criterion of relevance to the product strategic context (Lilien, 2007). In this study a cluster analysis was used to classify consumers into homogenous clusters, according to their preferences.

The calculations were performed with the Cluster module of the statistical software package SPSS 19, using first a hierarchical cluster analysis by using Ward´s method and afterwards a non-hierarchical methodology - the k-means cluster procedure. The inputs used were the coefficients of each respondent´s utility function.

A four-cluster solution was chosen as being in accord with: coefficient of agglomeration; dendogram observation, size of the segments, and number of iterations.

Having determined homogenous segments of consumers with respect to their preference functions, we calculate the relative importance for different consumer segments. The results are presented in Table 12.

Table 12 – Consumer segments performance profiling

Average attributes importance	Clusters (segments)			
	1 (n=24)	2 (n=36)	3 (n=19)	4 (n=19)
Price	**52%**	**24%**	22%	16%
Origin Information	5%	6%	4%	5%
Drink Colour	5%	9%	3%	4%
Bissap Information	4%	10%	4%	5%

Antioxidant Information	5%	7%	4%	5%
Calories	11%	**24%**	**52%**	13%
Package	18%	**20%**	11%	**52%**
Total	100%	100%	100%	100%

Cluster 1 is the smallest segment of the study and is distinguished by the greatest relative importance to the "Price". The relative importance's of all the other attributes (unless the Package) are close to each other far from the Price importance. We denominate this segment "Price Sensitive".

Cluster 2 encompasses the greatest fraction of consumers. For this segment there is no principal attribute, but it presents intermediate and similar importance value at three different attributes: price, package and calories. Due to this fact, we denominated this segment "Consumers without particular preferences".

Cluster 3 represents about one fifth of the consumers and corresponds to whom give the highest relative importance to the Calories. Besides the price, which is the second place of relative importance, all the other attributes are not so relevant to this group and all have lower values. We determined to call this group "Body Concerned"

Cluster 4 represents one fifth of the consumers and for this group the most important attribute is distinctly the package. All the other attributes have lower (and similar) relative importance. We denominated this segment "Package Attracted".

An analysis of variance showed that all segments differed significantly from each other with respect to the all attributes, unless "Origin information" and " "Antioxidant Information", which according to the clusters analysis are not relevant attributes for these group of consumers.

Table 13 – Analysis of Variance (ANOVA)

Attributes	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Price	0.667	3.000	0.011	94.000	**61.903**	0.000
Origin Information	0.001	3.000	0.003	94.000	0.555	0.646
Drink Colour	0.018	3.000	0.003	94.000	6.343	0.001
Bissap Information	0.032	3.000	0.003	94.000	9.635	0.000

Antioxidant Information	0.005	3.000	0.002	94.000	2.528	0.062
Calories	0.660	3.000	0.008	94.000	**78.083**	0.000
Package	0.666	3.000	0.010	94.000	**67.195**	0.000

According to this results the dimensions that can better distinguish the clusters are the "Calories", followed by "Package" and after by the "Price". All the other attributes are not so valorized by consumers. This is in agreement with the most evaluated attributes by the four clusters achieved.

Table 14 presents details of the four clusters in terms of their sociodemographic characteristics and frequency drink consumption. This information complements that on their preferences and allows one to a better approach a typology of consumers.

Table 14 – Sociodemographic and consumption pattern parameters (%) of four consumer cluster identified

Variables		Cluster				Sig (Chi^2)
		1	2	3	4	
Gender	Female	54%	56%	69%	47%	0,615
	Male	46%	44%	31%	53%	
Age (Years)	1 (18- 36)	50%	42%	58%	47%	0,714
	2 (37-58)	50%	58%	42%	53%	
Education	Master / PhD	25%	33%	42%	31%	0,256
	Bachalor	42%	42%	47%	63%	
	Secondary school or lower	33%	25%	10%	5%	
ESOMAR Social Classes	Class A,B	33%	33%	37%	10%	0,241
	Class C,D,E	67%	67%	63%	89%	
Employment	Functionary/Student	79%	75%	79%	74%	0,725
	Self-employed/Managment	21%	14%	16%	21%	
	Unemployed	0%	11%	5%	5%	

Principle member of income	yes	46%	53%	47%	42%	0,887
	no	54%	47%	53%	58%	
Drink Consumption Frequency	1 (daily to 4 times/week)	91%	81%	74%	79%	0,808
	2 (1-3 times/month)	8%	14%	21%	16%	
	3 (less than once a month)	0%	5%	5%	5%	
N.° of dependents	1 (0-2 children)	13%	17%	16%	5%	0,850
	2 (3 children)	46%	53%	58%	58%	
	3 (>3 children)	42%	30%	26%	37%	

The main characteristics of each segment are:

Cluster 1 – Price Sensitive – This segment can be characterized with the consumers that have the highest drink consumption frequency, the lowest level of education and do not include unemployed consumers.

Cluster 2 – Consumers without particular preferences - This is the group that has the highest level of persons with more than 36 years and also has the largest percentage of unemployed.

Cluster 3 – Body Concerned - the majority of this consumers segment are women, between 18 and 36 years and with 3 children.

Cluster 4 – Package Attracted – almost all consumers from this group have children and belongs to a lower/medium social classes, according to the ESOMAR criteria, but contrary what is normally expected, this group has the consumers with the highest degree of education.

According to Lilien (2007), a meaningful segmentation should satisfy three managerial criteria: 1) Homogeneity within the segments and Heterogeneity between them; 2) Identifiability: segments should be accessible and 3) Parsimony: the segmentation should be cost effective to implement. Although the possibility of distinguish four different clusters and characterize them, it was not possible to find significative differences (according to chi square analyses) between the clusters, so heterogeneity was not found, at least with the sociodemographic characteristics used on this study. The socioeconomic level is the variable that is closer to have significance, maybe using a biggest sample would be possible achieve significant differences. So, further and deep studies are necessary to obtain consumers segmentation significance, it might be to evaluate more and different types of sociodemographic characteristics or habits of consumption to achieve

Consumer study – CATA

1. Consumer Overall liking scores

As shown in Table 15, there were significant differences (P<0,001) in the overall liking scores. Regarding all samples used during consumer study it was possible to verify that all of the drinks were on the acceptable range since the mean scores were between 4 (dislike slightly) and 6 (like moderately). Instant drink was the most preferred followed by Syrup, 3H and 3C, in a decrease order of magnitude.

Table 15 - Mean overall acceptability scores for the Bissap drinks tested.

AC1

Sample	Mean	Groups		
Instantaneous	5,780	A		
Syrup	5,400	A	B	
3H	4,980		B	C
3C	4,770			C

6 - Like moderately
5 - Neither like nor dislike
4 - Dislike slightly

* Means with the same letter are not significantly different

2. Consumers segmentation using Hierarchical cluster analysis

The hierarchical cluster analysis (Ward method) identified three groups of consumers that scored the overall liking scores of the samples differently: Cluster 1 with 51 individuals, Cluster 2 with 8 and Cluster 3 with 41 consumers (Figure 7).

There were significant differences (P < 0.001) in the overall liking of the clusters, indicating different preference patterns (Table 16). Consumers in Cluster 1 gave the highest overall acceptability scores to Instant drink followed by Syrup, 3C and 3H; Cluster 2 includes consumers that gave highest overall acceptability scores to 3C followed by Instantaneous, 3H and Syrup and; Cluster 3 includes consumers that accepted in a decrease order of magnitude the Syrup followed by 3H, 3C and Instant drink.
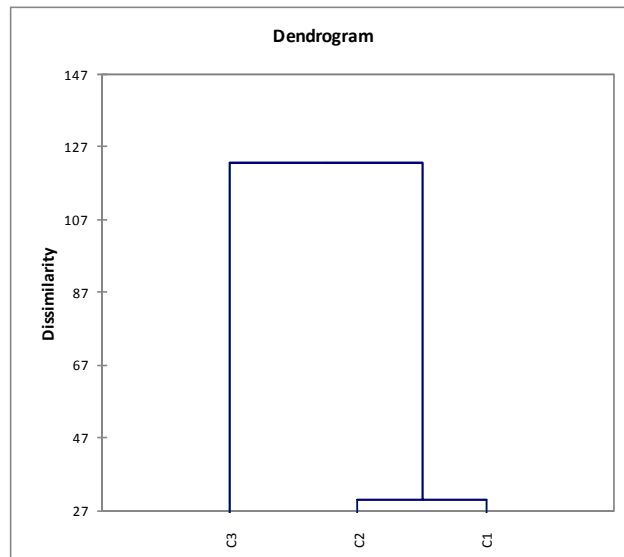
Figure 7 - Hierarchical cluster analysis of Bissap drinks consumers.

Table 16 - Bissap samples distributed into Cluster sorted by increasing order of preference.

Objects sorted by increasing preference order:

Cluster1	Cluster2	Cluster3
3H	Syrup	Instantaneous
3C	3H	3C
Syrup	Instantane	3H
Instantane	3C	Syrup

3. Check-All-That-Apply Question

Consumers were asked to evaluate the samples and to check all the terms that they considered appropriate to describe the sensory characteristics and emotional associations/perceptions using a questionnaire comprising 28 related terms. The most frequently selected terms were considered as the most used by consumers to describe the samples.

Table 17 shows the frequency in which each of the terms of the CATA question was used to describe the evaluated samples. The most frequently used terms were "red colour", "fruity", "artificial", "fluid", "clarity", "pink colour", "sweet", "strong" and "concentrated". Meanwhile, the least used term was "hay".

Significant differences (P<0,0001) were found in the number of terms used by consumers to describe the samples. As shown in Table 17, the largest number of terms was used to describe Samples 3H, 3C followed by Instantaneous drink and Syrup. This could be explained considering that consumers were more motivated to describe the samples that they considered more complex. Regarding the different categories in the CATA question, consumers used the terms related to the sensory characteristics of samples with a higher frequency than those

within the emotional associations; suggesting that consumers' perception was mostly centred in their sensory characteristics.

These results suggest that this type of question was able to detect differences in consumer's perception of the Bissap drinks.

Table 17 - Results of the Check-All-That-Apply question. Frequencies for each attribute and evaluated samples.

Category	Atributes	Samples				Frequency of mention	Frequency of mention/category	Average number of mentions/category
		3H	3C	Syrup	Instantaneous			
Sensory Attributes/ Characteristics	Red colour	81	77	33	18	209	1468	14,68
	Pink colour	11	19	43	55	128		
	Clarity	21	23	30	55	129		
	Viscous	31	22	9	4	66		
	Fluid	19	28	44	47	138		
	Flowers	20	18	22	26	86		
	Fruity	40	34	39	40	153		
	Fresh herb	13	7	13	13	46		
	Cold black tea	20	13	15	14	62		
	Raisins	11	11	9	5	36		
	Honey	12	11	21	3	47		
	Acid	30	49	5	8	92		
	Sweet	26	22	46	27	121		
	Bitter	26	27	10	16	79		
	Sour cherry	12	13	14	6	45		
	Hay	15	8	3	5	31		
Emotional associations/ Perceptions	Natural	12	13	19	21	65	972	9,72
	Artificial	45	38	40	25	148		
	Smooth	9	6	26	38	79		
	Bond	31	17	13	5	66		
	Rough	25	42	7	7	81		
	Healthy	7	8	11	15	41		
	Fresh	14	22	15	32	83		
	Instantaneous	12	11	11	14	48		
	Watery	11	8	16	43	78		
	Strong	44	43	21	5	113		
	Diluted	5	13	12	40	70		
	Concentrated	44	33	22	1	100		
	Total terms/sample	647	636	569	588			
	Average number of terms used in CATA question/sample	6,47	6,36	5,69	5,88			

Considering that the three identified clusters showed different preference patterns, they could have also used the terms of CATA question differently. Therefore, Multiple Factor Analysis (MFA) was carried on out considering CATA counts for groups of consumers.

Mulltipple factor analysis (MFA) was performed on responses in each category to the CATA question in order to identify relationships between the terms and the samples and to get a sensory map of the samples.

In what concerns sensory characteristics category, the first two dimensions of the MFA accounted for 81,54% of the variance of the experimental data; representing 61,17% and 20,38% of the variance for the first and second dimension, respectively. Regarding emotional associations category, the first two dimensions of the MFA accounted for 94,08% of the variance of the experimental data; representing 82,93% and 11,15% of the variance for the first and second dimension, respectively. Thus, most of the variance was explained by the first dimension.

Figure 8 a) shows the representation of the sensory terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was

positively correlated to terms red colour, viscous, cold black tea and raisins related to 3H sample; and to acid, bitter and hay attributes associated with 3C sample; and negatively correlated to terms pink colour, clarity and floral attributes related to instant drink sample. On the other hand, the second dimension was positively correlated to sweet, fruity and fresh herb representative of syrup sample.

Figure 8 b) shows the representation of emotional associations terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was positively correlated to terms fresh, instantaneous, diluted and watery being associated with Instant drink sample; and negatively correlated to concentrated and bond descriptors from 3H sample. The second dimension was positively associated to 3C sample with rough and strong terms; and negatively linked to natural and smooth attributes, which described Syrup sample.

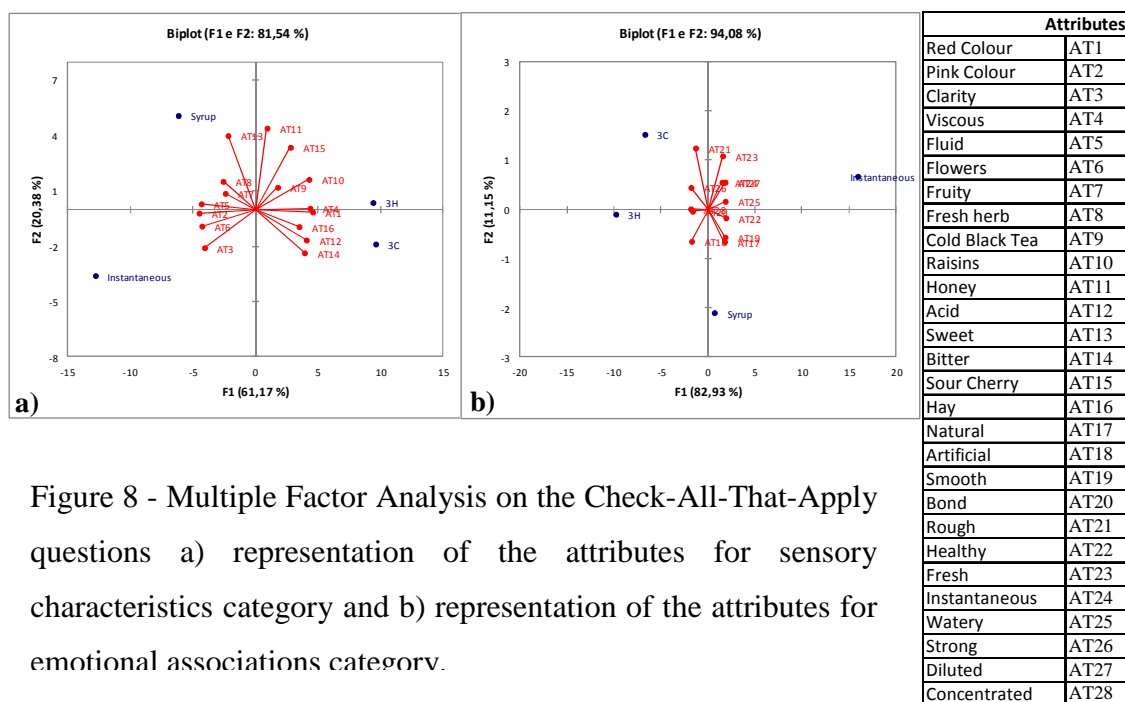| Attributes	
Red Colour	AT1
Pink Colour	AT2
Clarity	AT3
Viscous	AT4
Fluid	AT5
Flowers	AT6
Fruity	AT7
Fresh herb	AT8
Cold Black Tea	AT9
Raisins	AT10
Honey	AT11
Acid	AT12
Sweet	AT13
Bitter	AT14
Sour Cherry	AT15
Hay	AT16
Natural	AT17
Artificial	AT18
Smooth	AT19
Bond	AT20
Rough	AT21
Healthy	AT22
Fresh	AT23
Instantaneous	AT24
Watery	AT25
Strong	AT26
Diluted	AT27
Concentrated	AT28

Figure 8 - Multiple Factor Analysis on the Check-All-That-Apply questions a) representation of the attributes for sensory characteristics category and b) representation of the attributes for emotional associations category.

Since different categories of terms were included in the CATA question, samples were characterized not only in terms of sensory attributes, but also considering consumer perception of different aspects of the samples (emotional associations) and the overall liking of each one. The relationship between the categories of terms from the CATA question provided interesting information. As shown in Figure 9, all the categories were located close to each other in the first dimension of the MFA, which suggests that they provided similar information. MFA accounted for 89,65% of the total variance of the experimental data; representing 75,82% and 13,83% of the variance for the first and second dimension respectively. However, it is interesting to note that the group of terms related to sensory characteristics and emotional associations were highly correlated. This suggests that sensory characteristics seemed to have influenced consumers' emotional responses to Bissap drinks. Moreover, these two groups of terms were highly correlated to overall liking; suggesting that

sensory characteristics were the main determinants of consumers' hedonic and emotional response toward the evaluated Bissap drinks and that the most liked products raised more positive emotional responses in consumers.
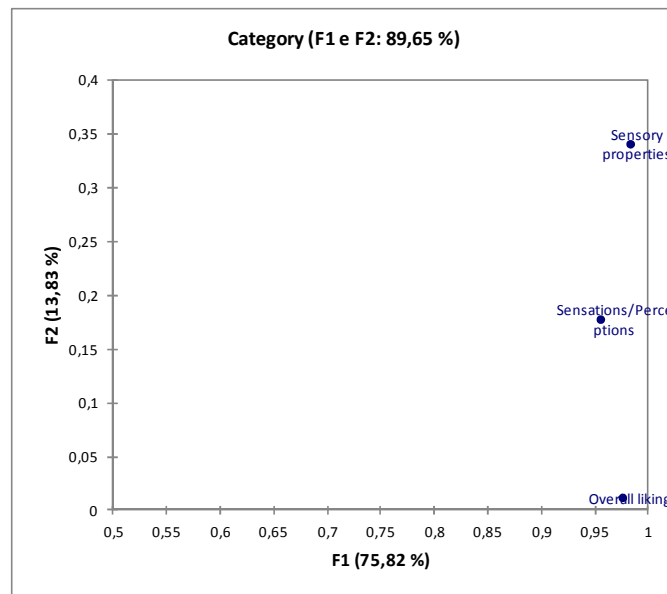

Figure 9 - Representation of the categories of terms from the CATA question and the overall liking scores in the first two dimensions of the MFA.

The approach of considering different categories of terms in a CATA question seems promising for studying the relationship of consumers' perception of sensory and non-sensory attributes of products. This is an interesting approach for R&D, Marketing and Communication departments to develop strategies for launching a new/or changed product to market. So, to more finely compare the level of agreement/disagreement between all categories considered on CATA question and overall liking scores, MFA was employed using the first two dimensions of the three maps created. Figure 10 represents the location of the Bissap drinks as optimal product determined for each of the three types of categories on the first two MFA factors (individual factor map).
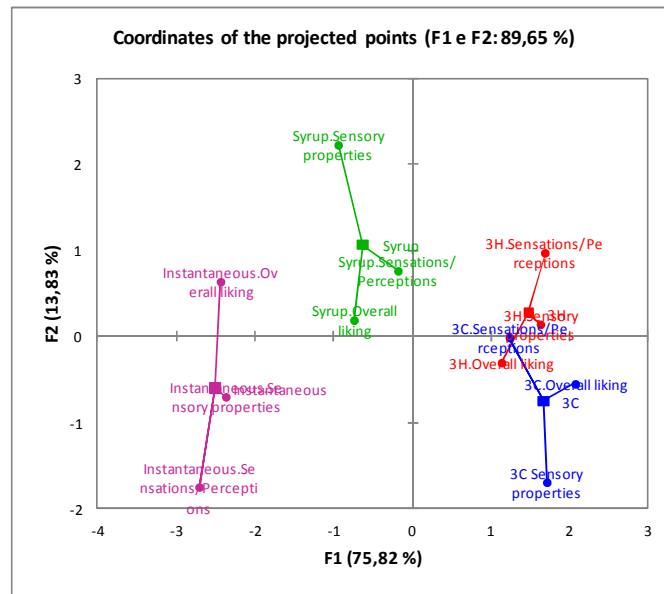
Figure 10 - Products' spatial representation /products' configuration (first two dimensions) determined using sensory characteristics, emotional associations and overall liking scores of consumers.

4. External Preference Mapping

Figure 11 shows the external preference map based on samples' configuration in the MFA of CATA counts. The contour plot shows lines corresponding to different percentage of consumers who scored their overall liking under a 9-point hedonic scale (1 = "dislike extremely, 9 = "like extremely").
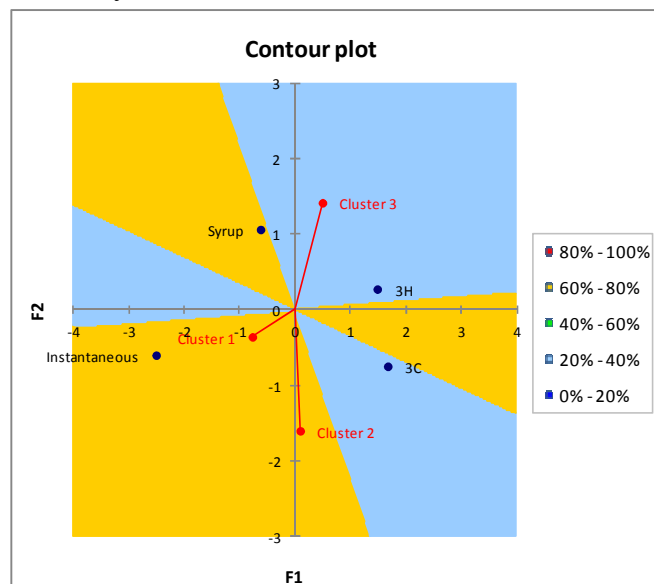

Figure 11 - External Preference Map based on consumers' perception of the samples, i.e., considering consensus samples' coordinates in the MFA of consumers' responses to the CATA.

The external preference map showed that Syrup and Instantaneous were located in an area where the percentage of consumers who liked them range between 60 and 80%, which is in

agreement with their mean overall liking scores. Samples 3H and 3C were located in zones where the consumers scored their overall liking lower than 6 ranged from 20% to 40%.

The advantage of this approach is that drivers of liking could be identified based only on consumers' perception of samples. As shown in Figures 8 and 10, the areas of maximum liking were correlated to products characterized with "positive" sensory attributes and emotional terms. Therefore, the application of external preference mapping based on consumers' responses to CATA questions seem to be a simple and quick alternative for companies that have difficulties to use trained assessors' panels. Despite their good results, it is important to take into account that responses to CATA questions are in terms of counts and not intensities as measured by a trained panel using intensity scales and therefore could not be considered supplementary methodologies.

5. Internal Preference Mapping

Figure 12 shows the internal preference map based on consumers' overall liking of Bissap drinks.
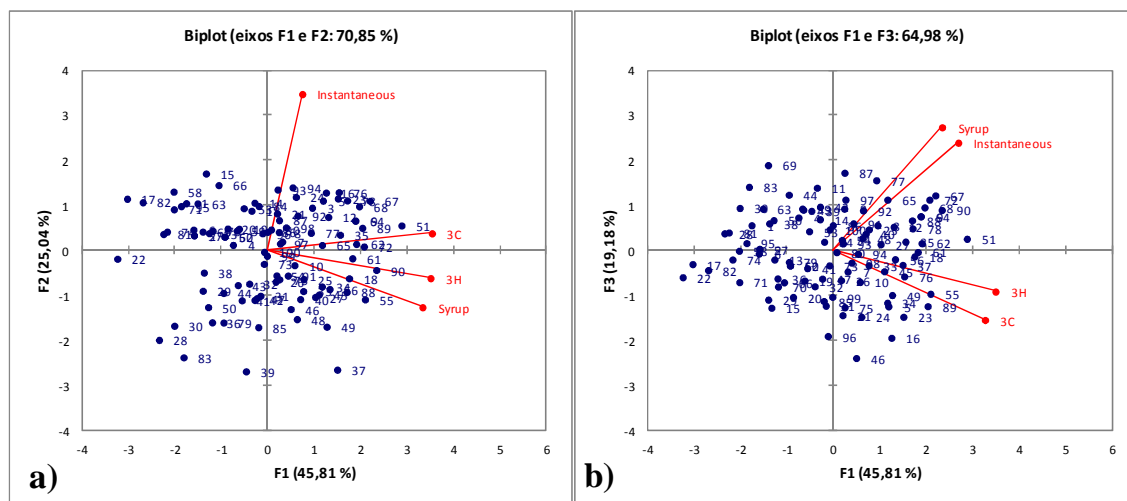

Figure 12 - Internal Preference Map based on consumers' overall liking samples.

The internal preference map showed three groups of consumer's preference: Group I - samples Syrup & Instantaneous with 26%, Group II – 3H & 3C with 25% and Group III – with no opinion with 49%, of overall liking scores.

b) Consumer preference study involving the English consumer for Bissap

Consumer study

1. Consumer Overall liking scores

As shown in Table 18, there were significant differences (P<0,001) in the overall liking scores.

Table 18 - Mean overall liking scores, concerning appearance, smell, taste, global appreciation; sweetness and willingness to buy, for the Bissap drinks tested.

Samples	Average (Appearance)	Groups		
Syrup	7,212	A		
Cold extraction	6,938	A		
Hot extraction	6,301		B	
Inst. Juice	6,239		B	

Samples	Average (Smell)	Groups		
Inst. Juice	6,442	A		
Syrup	5,354		B	
Cold extraction	4,920		B	C
Hot extraction	4,673			C

Samples	Average (Taste)	Groups	
Syrup	6,009	A	
Inst. Juice	5,920	A	
Cold extraction	5,035		B
Hot extraction	4,522		B

Samples	Average (Overall)	Groups		
Syrup	6,212	A		
Inst. Juice	6,035	A		
Cold extraction	5,381		B	
Hot extraction	4,814			C

Samples	Average (Sweetness)	Groups	
Syrup	5,646	A	
Cold extraction	4,982		B
Inst. Juice	4,841		B
Hot extraction	4,770		B

Samples	Average (WTB)	Groups	
Syrup	3,080	A	
Inst. Juice	2,991	A	
Cold extraction	2,434		B
Hot extraction	2,221		B

Means with the same letter are not significantly different

Regarding all samples used during consumer study it was possible to verify that all of the drinks were on the acceptable range since the mean scores were between 4 (dislike slightly) and 7 (like slightly), according to a 9-point scale, with the exception for the willingness to buy where the mean scores were between 2 (Probably would not buy) and 3 (I have some doubts if I would buy it or not) in a 5-point scale.

According to overall liking, syrup drink was the most preferred followed by instant drink, traditional cold extraction and traditional hot extraction drink, in a decrease order of magnitude. In what concerns sweetness, samples cold extraction, instant drink and hot extraction had an ideal concentration of sugar. Syrup had a slightly more sugar than ideal.
The results achieved for the willingness to buy were equal or below 3 (I have some doubts if I would buy it or not). Consumers preferred syrup and instant drink followed by cold and hot extraction samples.

2. Consumers segmentation using Hierarchical cluster analysis

The hierarchical cluster analysis (Ward method) identified three groups of consumers that scored the overall liking scores of the samples differently: Cluster 1 with 44 individuals, Cluster 2 with 54 and Cluster 3 with 15 consumers (Figure 13).
There were significant differences ($P < 0.001$) in the overall liking of the clusters, indicating different preference patterns (Table 19). Consumers in Cluster 1 gave the highest overall acceptability scores to syrup followed cold extraction sample, hot extraction sample and instant drink; Cluster 2 includes consumers that gave highest overall acceptability scores to instant drink followed syrup, cold extraction and hot extraction and; Cluster 3 includes consumers that accepted in a decrease order of magnitude the instant drink followed by syrup, hot extraction and cold extraction.
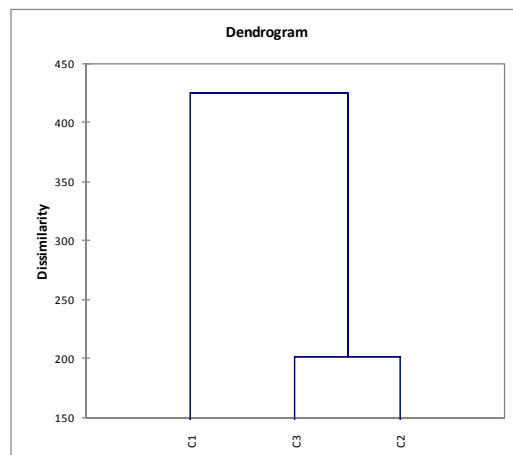

Figure 13- Hierarchical cluster analysis of Bissap drinks consumers.

Table 19 - Bissap samples distributed into Cluster sorted by increasing order of preference.

Objects sorted by increasing order of preference:

CLUSTER 1	CLUSTER 2	CLUSTER 3
INST.JUICE	HOT EXTRACTION	COLD EXTRACTION
HOT EXTRACTION	COLD EXTRACTION	HOT EXTRACTION
COLD EXTRACTION	SYRUP	SYRUP
SYRUP	INST.JUICE	INST.JUICE

As shown in Figure 14 Cluster 1 represents the "Bissap likers" (39%), Cluster 2 the "Commercial Bissap likers" (48%) and Cluster 3 the "Bissap dislikers" (13%), consumers. The products rated below five were considered as "disliked" and above five as "liked".
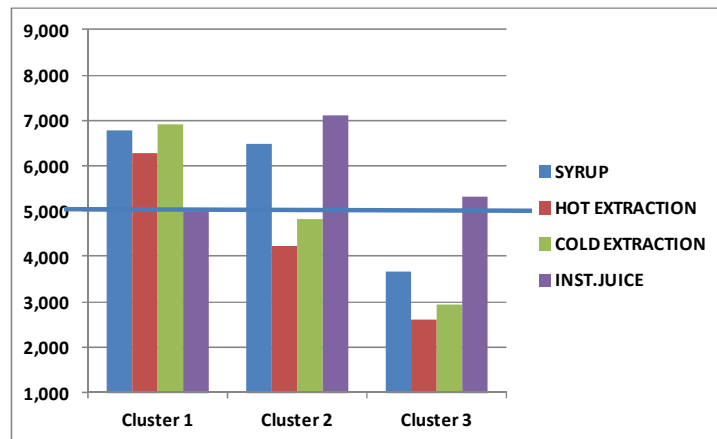

Figure 14 - Mean consumer acceptance of Bissap by cluster type.

3. Check-All-That-Apply Question

Consumers were asked to evaluate the samples and to check all the terms that they considered appropriate to describe the sensory characteristics and emotional associations/perceptions using a questionnaire comprising 28 related terms. The most frequently selected terms were considered as the most used by consumers to describe the samples.
Table 20 shows the frequency in which each of the terms of the CATA question was used to describe the evaluated samples.

The most frequently used terms were "red colour", "pink colour", "clarity", "fluid", "flowers", "fruity", "acid", "sweet", "natural", "artificial", "smooth", "healthy", "fresh", "strong" and "concentrated". Meanwhile, the least used term was "hay".
Significant differences ($P < 0,0001$) were found in the number of terms used by consumers to describe the samples. As shown in Table 20, the largest number of terms was used to describe the drinks obtained by hot extraction and cold extraction followed by syrup and instant drink. This could be explained considering that consumers were more motivated to describe the samples that they considered more complex. Regarding the different categories in the CATA question, consumers used the terms related to the sensory characteristics of samples with a higher frequency than those within the emotional associations; suggesting that consumers' perception was mostly centred in their sensory characteristics.

These results suggest that this type of question was able to detect differences in consumer's perception of the Bissap drinks.

Table 20 - Results of the Check-All-That-Apply question. Frequencies for each attribute and evaluated samples.

	SAMPLES						
Attributes	Hot extraction	Cold extraction	Syrup	Instantaneous juice	Frequency of mention	Frequency of mention/category	Average number of mentions/category
Red Colour	95	95	58	30	278		
Pink Colour	5	9	57	76	147		
Clarity	7	12	29	53	101		
Viscous	32	14	7	5	58		
Fluid	30	38	44	48	160		
Flowers	23	21	36	24	104		
Fruity	33	37	57	75	202		
Fresh herb	13	15	16	8	52	1730	15,31
Cold Black Tea	16	11	8	7	42		
Raisins	22	20	11	5	58		
Honey	12	15	30	9	66		
Acid	46	47	10	6	109		
Sweet	25	27	54	54	160		
Bitter	35	37	9	3	84		
Harsh	36	29	6	4	75		
Hay	13	11	5	5	34		
Natural	38	45	50	34	167		
Artificial	27	30	24	37	118		
Smooth	15	17	42	35	109		
Full Body	44	36	11	2	93		
Rough	34	33	11	6	84		
Healthy	25	22	27	28	102	1295	11,46
Fresh	11	20	38	32	101		
Like an Instant beverage	9	6	11	23	49		
Watery	1	3	17	67	88		
Strong	70	73	15	5	163		
Diluted	6	7	25	56	94		
Concentrated	61	49	13	4	127		
Total terms/sample	784	779	721	741			
Average number of terms used in CATA question/sample	6,94	6,89	6,38	6,56			

Considering that the three identified clusters showed different preference patterns, they could have also used the terms of CATA question differently. Therefore, Multiple Factor Analysis (MFA) was carried on out considering CATA counts for groups of consumers.
Mulltiple factor analysis (MFA) was performed on responses in each category to the CATA question in order to identify relationships between the terms and the samples and to get a sensory map of the samples.

Concerning the sensory characteristics category, the first two dimensions of the MFA accounted for 95,58% of the variance of the experimental data; representing 73,31% and 22,26% of the variance for the first and second dimension, respectively. Regarding the emotional associations category, the first two dimensions of the MFA accounted for 95,58% of the variance of the experimental data; representing 80,25% and 15,33% of the variance for the first and second dimension, respectively. Thus, most of the variance was explained by the first dimension.

Figure 15 a) shows the representation of the sensory terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was positively correlated to terms acid, cold black tea, viscous, harsh taste and hay related to hot extraction sample; and to raisins and bitter attributes associated with cold extraction

sample; and negatively correlated to terms pink colour, clarity and fruity attributes related to instant drink sample. On the other hand, the second dimension was positively correlated to sweet, flowers and honey representative of syrup sample.

Figure 15 b) shows the representation of emotional associations terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was positively correlated to terms concentrated, full bodied, astringent and strong being associated with cold and hot extraction samples; and negatively correlated to diluted, watery, like an instant beverage and artificial descriptors from instant drink sample; and with smooth and fresh terms associated to syrup sample.
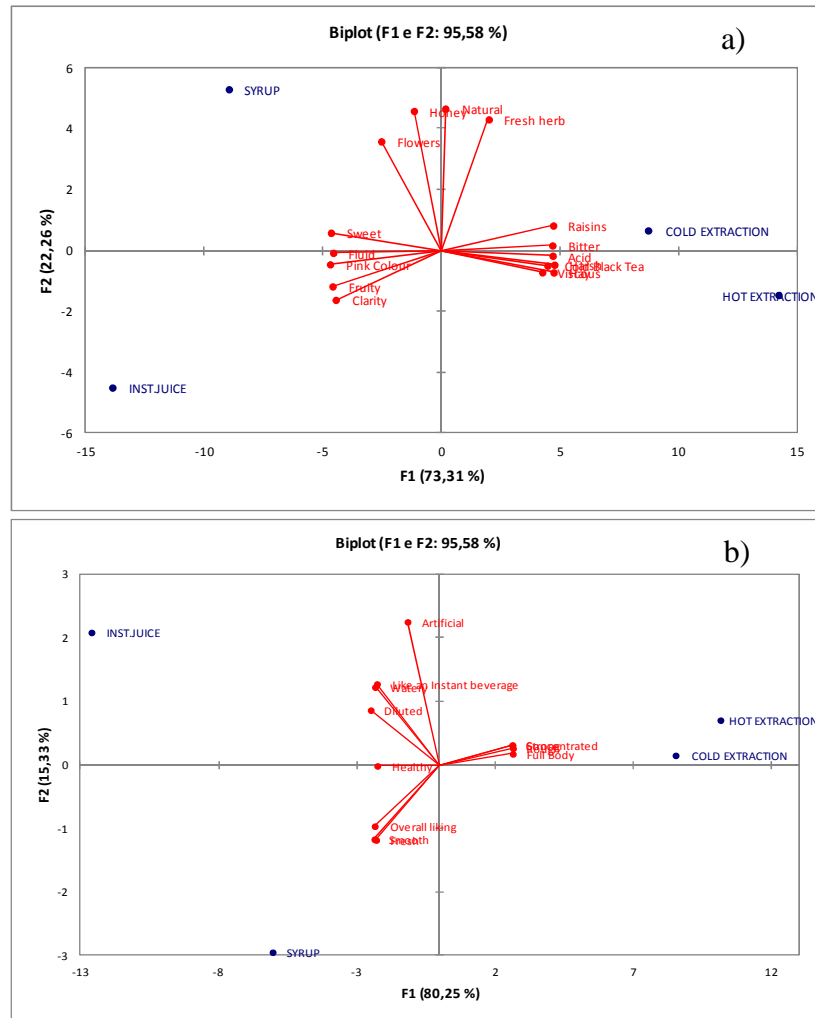

Figure 15 - Multiple Factor Analysis on the Check-All-That-Apply questions a) representation of the attributes for sensory characteristics category and b)

Since different categories of terms were included in the CATA question, samples were characterized not only in terms of sensory attributes, but also considering consumer perception of different aspects of the samples (emotional associations) and the overall liking of each one. The relationship between the categories of terms from the CATA question provided interesting information. As shown in Figure 16, all the categories were located close to each other in the first dimension of the MFA, which suggests that they provided similar

information. MFA accounted for 96,57% of the total variance of the experimental data; representing 82,19% and 14,38% of the variance for the first and second dimension, respectively. However, it is interesting to note that the group of terms related to sensory characteristics and emotional associations were highly correlated. This suggests that sensory characteristics seemed to have influenced consumers' emotional responses to Bissap drinks. Moreover, these two groups of terms were highly correlated to overall liking; suggesting that sensory characteristics were the main determinants of consumers' hedonic and emotional response toward the evaluated Bissap drinks and that the most liked products raised more positive emotional responses in consumers.
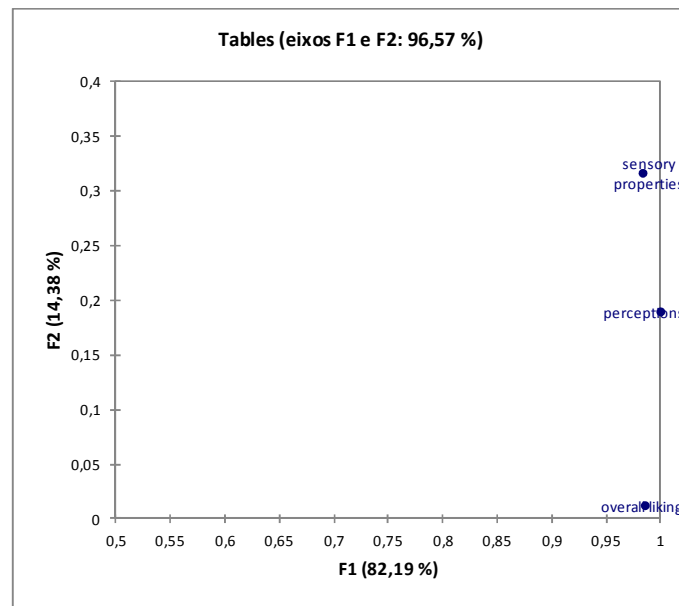

Figure 16 - Representation of the categories of terms from the CATA question and the overall liking scores in the first two dimensions of the MFA.

The approach of considering different categories of terms in a CATA question seems promising for studying the relationship of consumers' perception of sensory and non-sensory attributes of products. This is an interesting approach for R&D, Marketing and Communication departments to develop strategies for launching a new/or changed product to market. So, to more finely compare the level of agreement/disagreement between all categories considered on CATA question and overall liking scores, MFA was employed using the first two dimensions of the three maps created. Figure 17 represents the location of the Bissap drinks as optimal product determined for each of the three types of categories on the first two MFA factors (individual factor map).
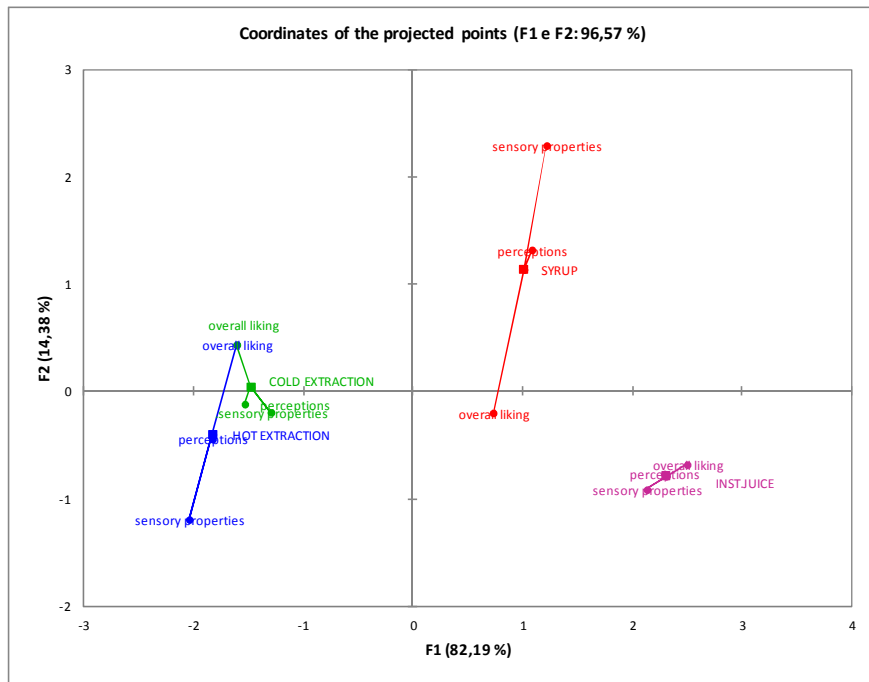
Figure 17 - Products' spatial representation /products' configuration (first two dimensions) determined using sensory characteristics, emotional associations and overall liking scores of consumers.

4. External Preference Mapping

Figure 18 shows the external preference map based on samples' configuration in the MFA of CATA counts. The contour plot shows lines corresponding to different percentage of consumers who scored their overall liking under a 9-point hedonic scale (1 = "dislike extremely, 9 = "like extremely").
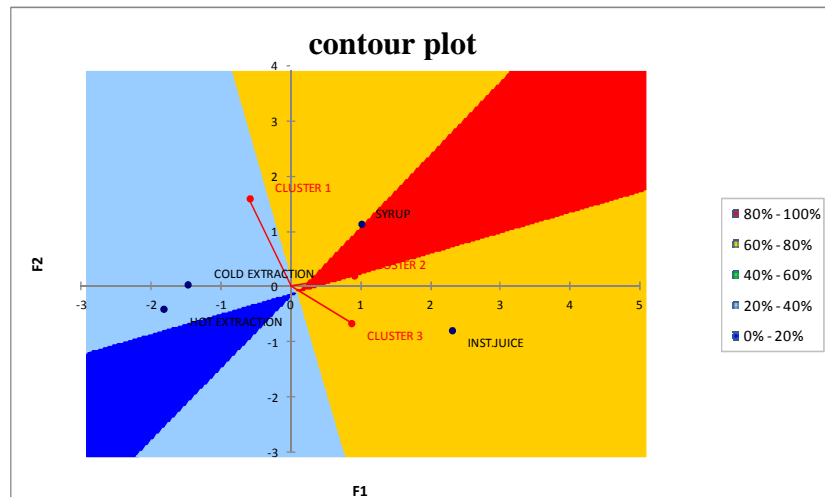

Figure 18 - External Preference Map based on consumers' perception of the samples, i.e., considering consensus samples' coordinates in the MFA of consumers' responses to the CATA.

The external preference MAP showed that Syrup and Instantaneous were located in an area where the percentage of consumers who liked them range between 60 and 100%, which is in agreement with their mean overall liking scores. Samples hot extration and cold extraction were located in zones where the consumers scored their overall liking lower than 6 ranged from 20% to 40%.

The advantage of this approach is that drivers of liking could be identified based only on consumers' perception of samples. As shown in Figures 15 and 17, the areas of maximum liking were correlated to products characterized with "positive" sensory attributes and emotional terms. Therefore, the application of external preference mapping based on consumers' responses to CATA questions seem to be a simple and quick alternative for companies that have difficulties to use trained assessors' panels. Despite their good results, it is important to take into account that responses to CATA questions are in terms of counts and not intensities as measured by a trained panel using intensity scales and therefore could not be considered supplementary methodologies.

5. Internal Preference Mapping

Figure 19 shows the internal preference map based on consumers' overall liking of Bissap drinks.
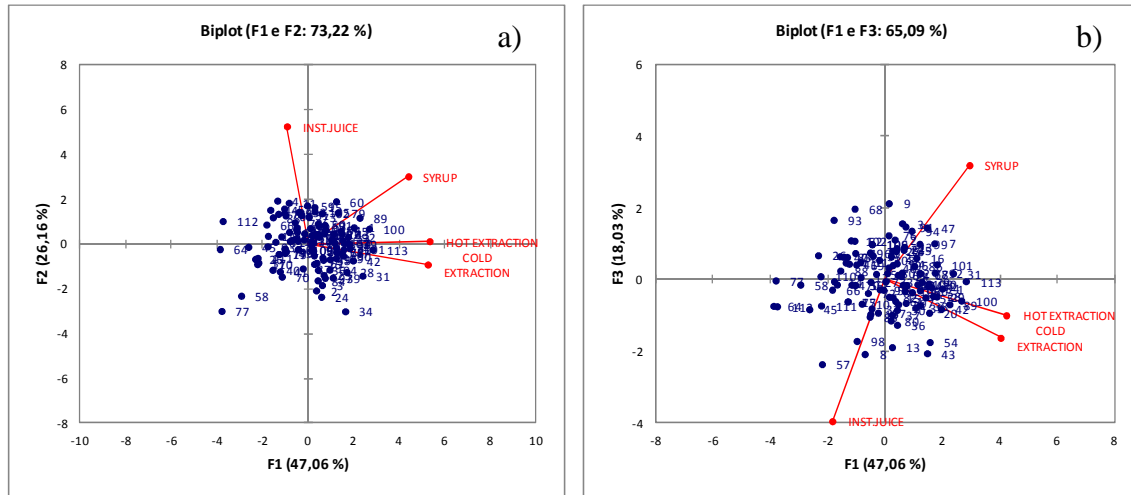
Figure 19 - Internal Preference Map based on consumers' overall liking samples.

The internal preference map showed three groups of consumer's preference: Group I - cold and hot extraction with 31%, Group II – syrup with 27%, Group III – instant drink with 23% and Group IV with no opinion representing 19%, of overall liking scores.

c) **Consumer preference study involving the French consumer for Bissap**

Consumer study

1. **Consumer Overall liking scores**

As shown in Table 21, there were significant differences (P<0,001) in the overall liking scores.

Table 21 - Mean overall liking scores, concerning appearance, smell, taste, global appreciation; sweetness and willingness to buy, for the Bissap drinks tested.

Category	Average (Appearance)	Groups		
Syrup	7,042	A		
Cold extraction	6,917	A		
Hot extraction	6,433		B	
Inst. Juice	5,825			C

Category	Average (Smell)	Groups	
Inst. Juice	6,292	A	
Syrup	6,067	A	
Cold extraction	5,275		B
Hot extraction	4,850		B

Category	Average (Taste)	Groups		
Syrup	6,417	A		
Inst. Juice	6,083	A	B	
Cold extraction	5,633		B	C
Hot extraction	5,517			C

Category	Average (Overall liking)	Groups	
Syrup	6,525	A	
Inst. Juice	6,042		B
Cold extraction	5,925		B
Hot extraction	5,667		B

Category	Average (Sweetness)	Groups	
Syrup	6,033	A	
Cold extraction	5,067		B
Inst. Juice	5,025		B
Hot extraction	4,942		B

Category	Average (WTB)	Groups	
Syrup	3,283	A	
Cold extraction	2,842		B
Hot extraction	2,750		B
Inst. Juice	2,725		B

Means with the same letter are not significantly different

Regarding all samples used during consumer study it was possible to verify that all of the drinks were on the acceptable range since the mean scores were between 4 (dislike slightly) and 7 (like slightly), according to a 9-point scale, with the exception for the willingness to buy where the mean scores were between 2 (Probably would not buy) and 3 (I have some doubts if I would buy it or not) in a 5-point scale.

According to overall liking, syrup was the most preferred followed by instant drink, cold extraction and hot extraction, in a decrease order of magnitude. In what concerns sweetness, samples cold extraction, instant drink and hot extraction had an ideal concentration of sugar. Syrup had a slightly more sugar than ideal.

The results achieved for the willingness to buy were equal or below 3 (I have some doubts if I would buy it or not). Consumers preferred syrup followed by cold extraction, hot extraction and instant drink samples.

2. Consumers segmentation using Hierarchical cluster analysis

The hierarchical cluster analysis (Ward method) identified three groups of consumers that scored the overall liking scores of the samples differently: Cluster 1 with 47 individuals, Cluster 2 with 51 and Cluster 3 with 22 consumers (Figure 20).

There were significant differences ($P < 0.001$) in the overall liking of the clusters, indicating different preference patterns (Table 22). Consumers in Cluster 1 gave the highest overall acceptability scores to syrup followed by cold extraction sample, hot extraction sample and instant drink; Cluster 2 includes consumers that gave highest overall acceptability scores to instant drink followed syrup, cold extraction and hot extraction and; Cluster 3 includes consumers that accepted in a decrease order of magnitude the hot extraction sample followed by cold extraction, syrup and instant drink samples.
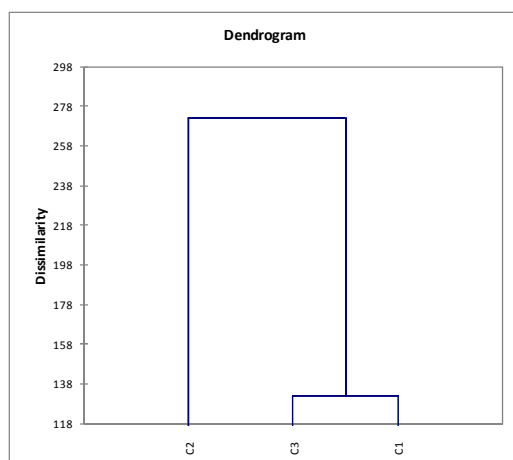

Figure 20 - Hierarchical cluster analysis of Bissap drinks consumers.

Table 22 - Bissap samples distributed into Cluster sorted by increasing order of preference.

Cluster 1	Cluster 2	Cluster 3
INST.JUICE	HOT EXTRACTION	INST.JUICE
COLD EXTRACTION	COLD EXTRACTION	SYRUP
HOT EXTRACTION	SYRUP	HOT EXTRACTION
SYRUP	INST.JUICE	COLD EXTRACTION

As shown in Figure 21 Cluster 1 represents the "Bissap likers" (39%), Cluster 2 the "Commercial Bissap likers" (43%) and Cluster 3 the "traditional Bissap likers" (18%), consumers.

The products rated below five were considered as "disliked" and above five as "liked".
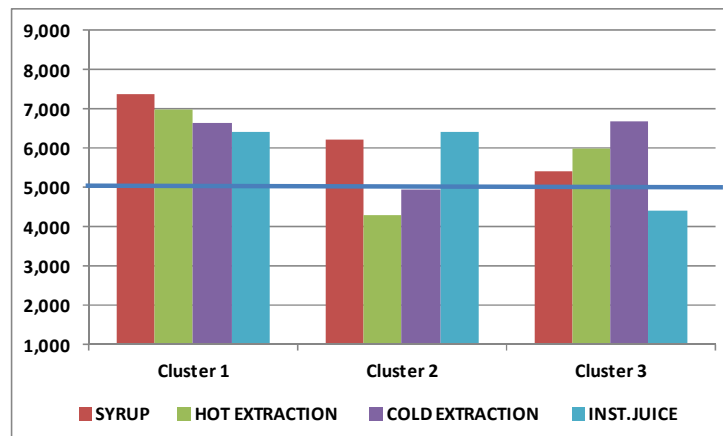

Figure 21 - Mean consumer acceptance of Bissap by cluster type.

3. Check-All-That-Apply Question

Consumers were asked to evaluate the samples and to check all the terms that they considered appropriate to describe the sensory characteristics and emotional associations/perceptions using a questionnaire comprising 28 related terms. The most frequently selected terms were considered as the most used by consumers to describe the samples.

Table 23 shows the frequency in which each of the terms of the CATA question was used to describe the evaluated samples.

The most frequently used terms were "red colour", "pink colour", "clarity", "fluid", "flowers", "fruity", "raisins", "acid" "sweet", "natural", "artificial", "fresh", "strong", "diluted" and "concentrated". Meanwhile, the least used term was "like an instant beverage" followed by "bitter".

Significant differences (P<0,0001) were found in the number of terms used by consumers to describe the samples. As shown in Table 23, the largest number of terms was used to describe hot extraction sample followed by cold extraction, syrup and instant drink samples. This could be explained considering that consumers were more motivated to describe the samples that they considered more complex. Regarding the different categories in the CATA question, consumers used the terms related to the sensory characteristics of samples with a higher frequency than those within the emotional associations; suggesting that consumers' perception was mostly centred in their sensory characteristics.

These results suggest that this type of question was able to detect differences in consumer's perception of the Bissap drinks.

Table 23 - Results of the Check-All-That-Apply question. Frequencies for each attribute and evaluated samples.

| Category	Attributes	SAMPLES				Frequency of mention	Frequency of mention/category	Average number of mentions/category
		Hot extraction	Cold extraction	Syrup	Instantaneous juice			
Sensory attributes	Red Colour	112	111	55	9	287	1927	16,06
	Pink Colour	2	5	53	69	129		
	Clarity	1	3	47	96	147		
	Viscous	29	14	3	0	46		
	Fluid	30	42	58	69	199		
	Flowers	27	23	39	36	125		
	Fruity	34	38	65	62	199		
	Fresh herb	28	25	14	2	69		
	Cold Black Tea	27	20	9	4	60		
	Raisins	29	37	35	18	119		
	Honey	7	11	23	8	49		
	Acid	53	70	12	8	143		
	Sweet	27	28	63	56	174		
	Bitter	13	11	2	0	26		
	Harsh	31	26	5	4	66		
	Hay	42	33	10	4	89		
Emotional associations/perceptions	Natural	52	48	52	25	177	1120	9,33
	Artificial	15	13	25	64	117		
	Smooth	10	5	42	12	69		
	Full Body	35	33	3	0	71		
	Rough	32	34	7	2	75		
	Healthy	17	16	19	13	65		
	Fresh	26	23	38	46	133		
	Like an Instant beverage	1	1	8	14	24		
	Watery	6	6	13	40	65		
	Strong	46	53	8	0	107		
	Diluted	0	1	28	74	103		
	Concentrated	57	42	14	1	114		
	Total terms/sample	789	772	750	736			
	Average number of terms used in CATA question/sample	6,58	6,43	6,25	6,13			

Considering that the three identified clusters showed different preference patterns, they could have also used the terms of CATA question differently. Therefore, Multiple Factor Analysis (MFA) was carried on out considering CATA counts for groups of consumers.

Mulltiple factor analysis (MFA) was performed on responses in each category to the CATA question in order to identify relationships between the terms and the samples and to get a sensory map of the samples.

In what concerns sensory characteristics category, the first two dimensions of the MFA accounted for 96,18% of the variance of the experimental data; representing 81% and 15,19% of the variance for the first and second dimension, respectively. Regarding emotional associations category, the first two dimensions of the MFA accounted for 98,24% of the variance of the experimental data; representing 75,24% and 22,99% of the variance for the first and second dimension, respectively. Thus, most of the variance was explained by the first dimension.

Figure 22 a) shows the representation of the sensory terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was positively correlated to terms acid, viscous, harsh taste, bitter and hay related to hot extraction sample; and to cold black tea and fresh herb attributes associated with cold extraction sample; and negatively correlated to terms pink colour, clarity and fluid attributes related to instant drink sample. On the other hand, the second dimension was positively correlated to sweet, flowers, fruity and honey representative of syrup sample.

Figure 22 b) shows the representation of emotional associations terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was positively correlated to terms like an instant beverage, diluted, artificial and watery being associated with instant drink sample; and to the term smooth for the syrup sample; and negatively correlated to concentrated, full body, rough and strong descriptors from cold and hot extraction samples.
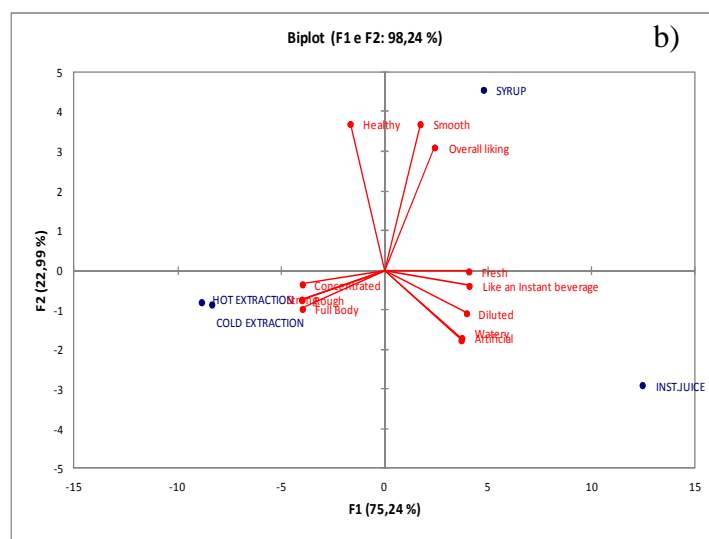

Biplot (F1 e F2: 96,18 %) a)
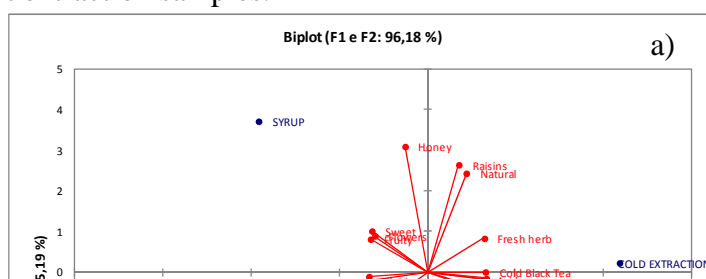
Figure 22 - Multiple Factor Analysis on the Check-All-That-Apply questions a) representation of the attributes for sensory characteristics category and b) representation of the attributes for emotional association category.

Since different categories of terms were included in the CATA question, samples were characterized not only in terms of sensory attributes, but also considering consumer perception of different aspects of the samples (emotional associations) and the overall liking of each one. The relationship between the categories of terms from the CATA question provided interesting information. As shown in Figure 23, all the categories were located close to each other in the first dimension of the MFA, which suggests that they provided similar information.

MFA accounted for 97,83% of the total variance of the experimental data; representing 83,47% and 14,36% of the variance for the first and second dimension respectively. However, it is interesting to note that the group of terms related to sensory characteristics and emotional associations were highly correlated. This suggests that sensory characteristics seemed to have influenced consumers' emotional responses to Bissap drinks. Moreover, these

two groups of terms were highly correlated to overall liking; suggesting that sensory characteristics were the main determinants of consumers' hedonic and emotional response toward the evaluated Bissap drinks and that the most liked products raised more positive emotional responses in consumers.
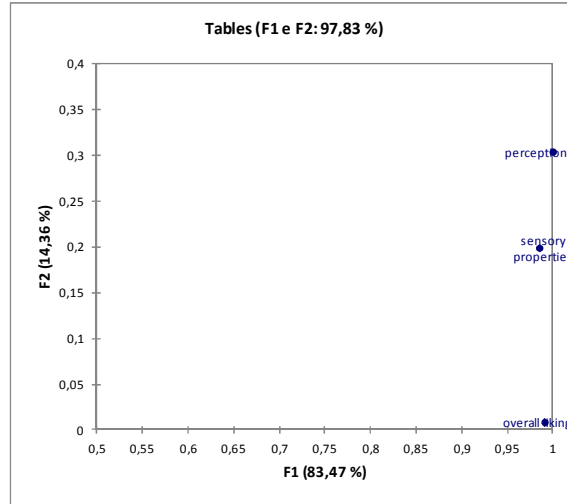

Figure 23 - Representation of the categories of terms from the CATA question and the overall liking scores in the first two dimensions of the MFA.

The approach of considering different categories of terms in a CATA question seems promising for studying the relationship of consumers' perception of sensory and non-sensory attributes of products. This is an interesting approach for R&D, Marketing and Communication departments to develop strategies for launching a new/or changed product to market. So, to more finely compare the level of agreement/disagreement between all categories considered on CATA question and overall liking scores, MFA was employed using the first two dimensions of the three maps created. Figure 24 represents the location of the Bissap drinks as optimal product determined for each of the three types of categories on the first two MFA factors (individual factor map).
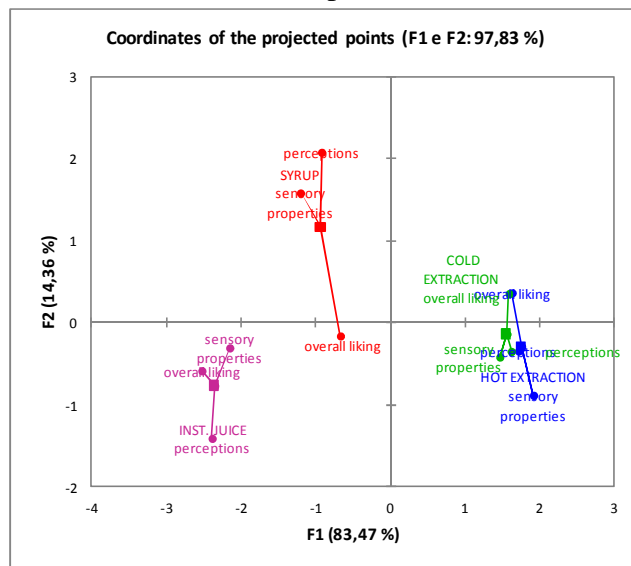
Figure 24 - Products' spatial representation /products' configuration (first two dimensions) determined using sensory characteristics, emotional associations and overall liking scores of consumers.

4. External Preference Mapping

Figure 25 shows the external preference map based on samples' configuration in the MFA of CATA counts. The contour plot shows lines corresponding to different percentage of consumers who scored their overall liking under a 9-point hedonic scale (1 = "dislike extremely, 9 = "like extremely").
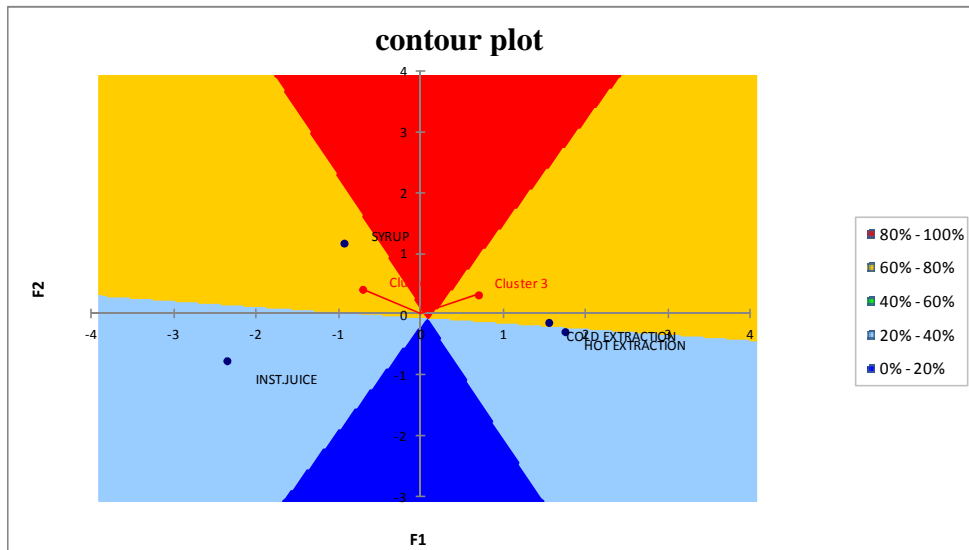

Figure 25 - External Preference Map based on consumers' perception of the samples, i.e., considering consensus samples' coordinates in the MFA of consumers' responses to the CATA.

The external preference map showed that syrup and cold extraction samples were located in an area where the percentage of consumers who liked them range between 60 and 80%, which is in agreement with their mean overall liking scores. Samples hot extraction and instant drink were located in zones where the consumers scored their overall liking lower than 6 ranged from 20% to 40%.

The advantage of this approach is that drivers of liking could be identified based only on consumers' perception of samples. As shown in Figures 22 and 24, the areas of maximum liking were correlated to products characterized with "positive" sensory attributes and emotional terms. Therefore, the application of external preference mapping based on consumers' responses to CATA questions seem to be a simple and quick alternative for companies that have difficulties to use trained assessors' panels. Despite their good results, it is important to take into account that responses to CATA questions are in terms of counts and not intensities as measured by a trained panel using intensity scales and therefore could not be considered supplementary methodologies.

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5. Internal Preference Mapping

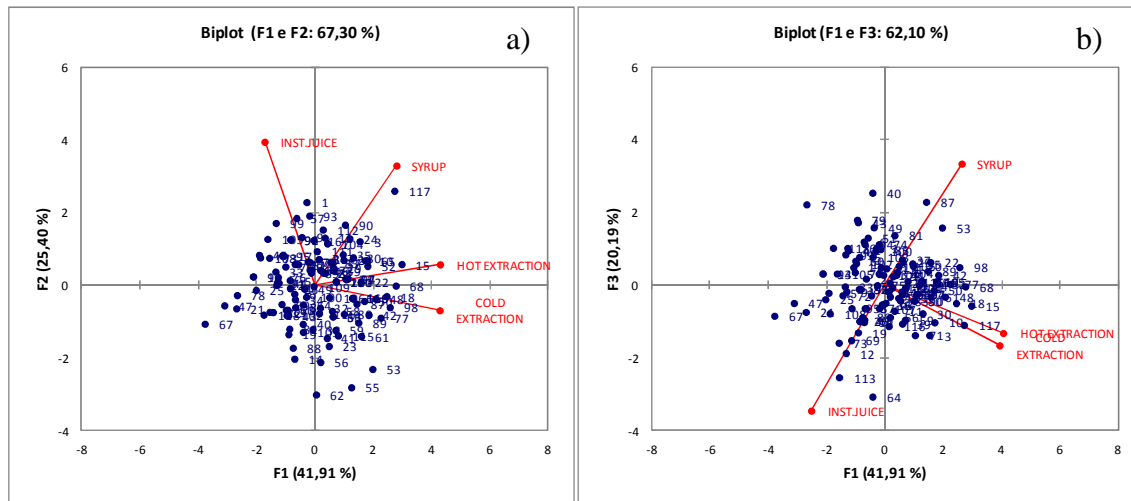Figure 26 shows the internal preference map based on consumers' overall liking of Bissap drinks.

Figure 26 - Internal Preference Map based on consumers' overall liking samples.

The internal preference map showed three groups of consumer's preference: Group I - cold and hot extraction samples with 27,5%, Group II –instant drink with 25%, Group III – syrup with 22,5% and Group IV with no opinion representing 25%, of overall liking scores.

Conclusions

The Bissap drink is not commonly consumed in Europe and even unknown to the general public. However due to its composition it might be a great potential to be considered a functional drink which probably increases the consumer interests and market acceptance. In consumer behaviour about food, one of the main challenges is to identify the important factors for consumer acceptance and choice, and that is the goal of this study related to Bissap drink for European consumers.

Comparing the results achieved in each country it is possible to verify, in what concerns hedonic study, two clusters: the first one composed by Portugal and the second by France and United Kingdom, according to the similarities obtained. Cluster 1 represents 29,4 % and Cluster 2 70,6% of consumers interviewed. Cluster 1 preferred instant drink and cluster 2 syrup drink . Cluster 1, in terms of ideal sweetness preferred instant drink followed by hot extraction drinks and, their attitude to buy falls on instant drink. Cluster 2, in what concerns ideal sweetness preferred cold extraction followed by instant drink and hot extraction drinks.

Syrup is slightly sweeter than the other samples. In terms of their attitude to buy, they preferred syrup drink.

CATA questionnaire results revealed that is possible to establish an European consumer profile of *Hibiscus sabdariffa L.* drinks. Results from Portugal, France and United Kingdom are quite similar for all categories under study, namely sensory properties and emotions/perceptions attributes. Regarding sensory attributes, instant drink is described with pink colour and clarity; syrup with sweet; hot extraction drink with viscous and cold extraction with bitter, attributes. In what concerns emotions/perceptions, instant drink is characterized with the terms like an instant beverage, diluted and watery; syrup with smooth; hot extraction drink with concentrated and full bodied and cold extraction with strong, attributes.

Highly significant differences were found in the frequencies in which CATA terms were used for describing the four samples, suggesting that this methodology was able to detect differences in consumer perception of the drinks.

Considering results from the present study, the use of CATA questions could be an interesting and simple methodology to get an insight on consumer perception of a food product. Using this methodology, a map of the samples could be generated taking only consumer perception of the products.

The use of CATA questions could be a simple way to perform external preference mapping when a sensory trained panel is not available or when there is not enough time to train a sensory panel. In this way, the use of the CATA question could consist on a complementary technique to traditional preference mapping.

These technologies seem to be promising for studying the relationship of consumers' perception of sensory and non-sensory attributes of products. This is an interesting approach for R&D, Marketing and Communication departments to develop strategies for launching a new/or changed product to market.

Hedonic		PT	FR	UK
Overall liking (in a decrease order of magnitude)		instantaneous juice > syrup > hot extraction > cold extraction	syrup > instantaneous juice > cold extraction > hot extraction	syrup > instantaneous juice > cold extraction > hot extraction
Sweetness (ideal)		instantaneous juice followed by hot extraction. Syrup is slightly more sweet than the other samples. Cold extraction is slightly less sweet than the other samples.	cold extraction, instantaneous juice, hot extraction. Syrup is slightly more sweet than the other samples.	cold extraction, instantaneous juice, hot extraction. Syrup is slightly more sweet than the other samples.
WTB		instantaneous juice	syrup followed by cold extraction	syrup followed by instantaneous juice
CATA questionnaire		PT	FR	UK
Sensory properties	instantaneous juice	pink colour, clarity, floral	pink colour, clarity, fluid	pink colour, clarity, fruity
	syrup	sweet, fruity, fresh herb	sweet, flowers, fruity, honey	sweet, flowers, honey
	hot extraction	red colour, viscous, cold black tea, raisins	acid, viscous, harsh taste, bitter, hay	acid, cold black tea, viscous, harsh taste, hay
	cold extraction	acid, bitter, hay	cold black tea, fresh herb	raisins, bitter
Emotions/Perceptions	instantaneous juice	fresh, like an instant beverage, diluted, watery	like an instant beverage, diluted, artificial, watery	diluted, watery, like an instant beverage, artificial
	syrup	natural, smooth	smooth	smooth, fresh
	hot extraction	concentrated, full bodied	concentrated, full bodied, astringent, strong	concentrated, full bodied, astringent, strong
	cold extraction	bitter, strong	concentrated, full bodied, astringent, strong	concentrated, full bodied, astringent, strong

So the present results collected as baseline of consumer perception and acceptance of traditional hibiscus based drinks allowed to confirm the similarities of consumer profile among three European countries (Portugal, England and France) concerning the same drinks and will support the reengineering of Hibiscus drinks performed in the next steps. Finally, the new methodologies approaches implemented in these studies showed efficiency and high discriminatory value, which prove to be a good tool in this type of studies and high applicability in following consumer tests in the AFTER project.

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<u>**I. Baobab study**</u>

a) Sensory evaluation and consumer preference studies involving the Portuguese consumer for Baobab

Introduction

The Baobab tree has an Arabic history, and belongs to the Bombacaceae family and Adansonia gender. There are eight species in the world including *Adansonia digitata L.* which is found in Senegal. This species is encountered in many African zones and has a long life. In many parts of Africa tubers, fruits, seeds, leaves and flowers of this plant are identified as common ingredients in traditional dishes in rural and urban areas. Also, baobab is an important source of income for Senegalese people and solely valorised in traditional ways.

From its English common name baobab by translation, the fruit is probably derived from the Arabic bu hibab, which means "fruit with several seeds». This fruit is a poly sperm berry, ovoid, with ligneous epicarp. The numerous linked seeds coated with whitish pulp are generally dried.

Baobab fruit is called "Bouy" or Monkey bread is widely used by Senegalese people and it is consumed in different forms. The pulp is probably the most important foodstuff in baobab fruit because of the strongest economic potential as compared to the remaining parts.

Figure 27 - Baobab fruit: outside, inside the outer shell and Baobab tree.

The ripe fruit pulp is naturally dehydrated and ivory coloured. It appears as a dry, mealy powder. Baobab is a popular food source. The fruit pulp is commonly sucked, chewed or made into a drink when mixed with water or milk, either with or without sugar, or as a supplement to mix with staple food such as corn meal and cassava. Other uses for baobab pulp include sauces for food, hair rinse, milk curdling agent and a sub-stitute for cream of tartar, among other things. When burned, it is a good repellent for cattle flies.

The pulp is very nutritious. Arnold et al. (1985) reported that with an average of 8.7% moisture, the pulp contains about 74% carbohydrates, 3% proteins, 9% fibers, 6% ash and only 0.2% fat. The content of pectin is approximately 56% (Nour et al., 1980), which is why the pulp is traditionally used as a base for jam making. It is also characterized by a high vitamin C (ascorbic acid), calcium, phosphorus and potassium content. The acidulous taste is attributed to the presence of organic acids, such as citric acid, tartaric acid, malic acid and succinic acids.

Baobab fruit pulp has a particularly high antioxidant capability mainly because of its high natural vitamin C content, which is equivalent to 6 oranges per 100 g. Antioxidants protect the cells of organisms from damage by free radicals. A deficiency of vitamin C weakens the immune system and promotes the susceptibility to disease. Deficiency of vitamin C also results in scurvy. The recommended daily allowance (RDA) for ascorbic acid is 75 mg for women and 90 mg for men. If we consider that baobab has an ascorbic acid content of 300 mg per 100 g pulp, the oral intake of 25 and 30 g, respectively is able to provide the daily vitamin C allowance required by humans. Additionally, vitamin C aids the bodily uptake of iron and calcium, of which the fruit pulp contains more than double than the same amount of milk. Therefore, in some areas, it is used as a milk substitute for babies.

Domestic (African) Uses

The dry pulp is either eaten fresh or used to add to gruels on cooling after cooking – a good way of preserving the vitamin contents. It can also be ground to make a refreshing drink with a pleasing wine-gum flavour. In Tanzania, it is added to aid fermentation of sugar cane for beer making (Fleuret, 1980).

When the fruit is ripe, the pulp is removed from the fibres and seeds by kneading in cold water: the resulting emulsion is seived. This is then added to thick grain preparations to make thinner gruels. The cattle-owning Fulani and the Hausa of northern Nigeria use the fruit pulp emulsion to mix with milk as a drink.

Pulp can be stored for fairly long periods for use in soft drink production but it needs airtight containers. Storage is improved by the use of sodium metabisulphite (Ibiyemi et al., 1988). It can also be frozen if ground to a powder (Obizoba and Amaechi, 1993). Baobab powder mixtures are commonly available in many public markets, but quality can be poor and some can be fraudulent.

Fruit pulp is usually sundried, but occasionally fermented, for use in cooking.

Uses in the US and Europe

Baobab fruit pulp, due to the combination of health claims (such as prebiotic and antioxidant functions, the high calcium content, and the anti-inflammatory properties) and food technological functions (because of its high pectin and fiber content, baobab fruit pulp gives beverages a thicker consistency and can be also used as filler), is a very interesting candidate for a new generation of functional foods and drinks.

Baobab fruit pulp can be particularly interesting as an ingredient for smoothies, which are a kind of thick fruit juice with a high content of fruit pulp.

From July 2008, "An exotic fruit with six times the vitamin C of an orange can be sold in Britain after an EU ruling. Baobab fruit has twice as much calcium as milk and is very high in antioxidants, iron and potassium. It will not be sold as a whole fruit as the shell is too hard to crack, instead it will be available in cereal bars and smoothies. The fruit had not been allowed into the UK because legislation prevents the importation of food which has not been commonly consumed in the EU before 1997. All new foods have to be formally approved before they can go on sale. The baobab fruit won approval

following heavy lobbying from PhytoTrade Africa, an organisation that promotes fair trade."

Food companies increasingly base their product development, positioning, advertisement and communication strategies on consumer perception (Faye et al., 2006; Van Trijp et al., 2007). In this context, understanding how consumers describe the sensory characteristics of food products is highly valuable for food companies. Traditionally, information about the sensory characteristics of a food product has been obtained using trained assessors' panels. This information is extremely valuable during product development for optimizing the products' formulation (Carr et al., 2001). However, trained assessors could describe the product differently or take into account attributes that may be irrelevant for consumers (Ten Kleij and Musters, 2003). Thus, in order to gather a better understanding of consumers' perception of food products it is necessary to study how consumers perceive and describe individual and multi-attribute changes in food products' sensory characteristics (Carr et al., 2001). Moreover, according to Dubois and Giboreau (2006) an inventory of the linguistic resources used in different languages and different senses for different food products is needed in order to better contrast consumers' experiences with trained assessors' data. Obtaining vocabularies directly from consumers has been traditionally considered tedious and difficult to interpret due to several drawbacks such as bias due to the interviewer, consumers' difficulty in describing the product's sensory characteristics and difficulty of analyzing consumers' heterogeneous responses (Piggot et al., 1990). However, some simple methodologies, such as free listing and check-all-that-apply questions, have been recently introduced to consumer science, which could be useful to identify consumers' vocabulary. One of the most novel methodologies that has been developed for gathering information about consumers' perception of the sensory characteristics of food products is the use of check-all-that-apply questions (CATA). A CATA question consists of a list of words or phrases from which respondents should select all the words they consider appropriate to describe a product. This type of question has been used in consumer studies to determine which sensory attributes consumers perceive in a food product (Adams et al., 2007; Dooley et al.,2010; Ares et al, 2010).

The aim of the present work was gather information about sensory profile by a trained panel by QDA approach and explore sensory and emotional attributes by small focus groups to apply CATA questions to study consumer perception in the development of *Adansonia digitata L.* drinks, and to compare results with those achieved using a trained assessors' panel. Four samples (n=4) were tested including three commercial ones - Commercial juice from Esteval, Commercial syrup from Esteval and Commercial syrup from Kumba and one prepared according traditional recipe - viz. Traditional boiled instantaneous powder,
A consumer study was performed with 100 people from a public local shopping center; who were asked to score their overall liking and to answer a CATA questionnaire that included 29 sensory and hedonic terms. Besides, the samples were evaluated by a trained assessors' panel. Sensory profiles of selected drinks were determined using a

trained panel (n=8) and an established Baobab drink sensory language. Sensory attributes were generated during preliminary focus group sessions guided by a panel leader.

Material and Methods

Samples

The Baobab samples for sensory tests were from three different types: Commercial juice - Esteval; Syrups from Esteval and Kumba and instantaneous powder (no reference).

Four different samples (traditional and commercial) were presented to the panellists as the following:

1. Traditional boiled instantaneous powder
2. Commercial juice from Esteval
3. Commercial syrup from Esteval
4. Commercial syrup from Kumba

Traditional sample was prepared using local traditional practices under good safety conditions. Aqueous powder sample was boiled (62,5 g/L), cooled and filtered. Sugar (140 g/L) was added after filtration.

Ethical assessment and consent

This study has been assessed and approved by the NRI Ethics Committee. Consent was signed by sensory panellists and consumers which participated in this study. Interviewers informed participants about the study and explained that their participation was entirely voluntary, that they could stop the interview at any point/time and that the responses would be anonymous.

Sensory evaluation

The Baobab samples were evaluated and scored by a trained sensory panel (as described on ISO 11035:1994 Sensory analysis — Identification and selection of descriptors for establishing a sensory profile by a multidimensional approach - Standard Operation Procedure 2 (SOP 2)), according Figure 28.
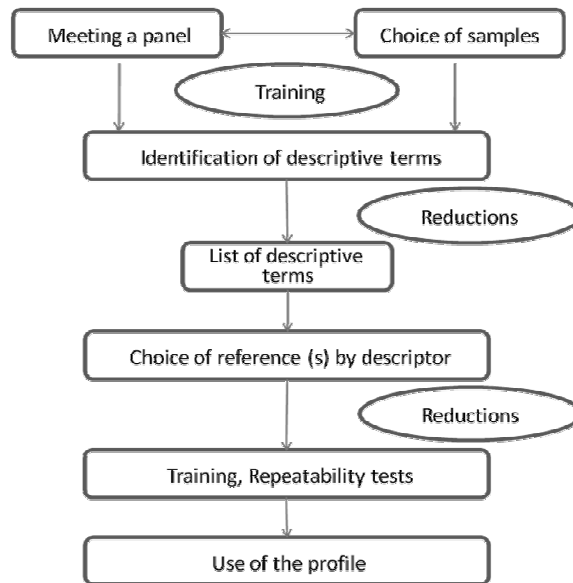
Figure 28 - Sensory profile methodology applied to Baobab samples

The panel was composed by university employees and students (n=8). Said subjects were selected according their sensory ability and familiarity with drinks. Sessions were conducted at sensory rooms with controlled room/air temperature and lightning. The language used for the sensory testing was Portuguese and English.

Sensory attributes were generated during preliminary focus group sessions guided by a panel leader. A total of 13 sensory attributes were developed, with correspondent references/or anchors, with panel consensus, as represented in Table 24 and Table 25, respectively.

Table 24 - Baobab Drink - Attributes definition.

Baobab Drink - Attributes definition

ATTRIBUTES	DEFINITION
APPEARANCE	
TURBIDITY (0-weak, 5-strong)	is the "optical property that causes light to be scattered scattered and absorbed rather than transmitted in straight and absorbed rather than transmitted in straight lines through the sample.
VISCOSITY (1-low, 5-high)	in everyday terms (and for fluids only), viscosity is "thickness". Thus, water is "thin", having a lower viscosity, while honey is "thick", having a higher viscosity.
ODOUR EVALUATION	
ODOUR/SMELL	
HERBACEOUS	herbaceous: General term (see also "vegetal") for a product with "green," "grassy" or "hay-like" aroma or flavor.
grass (0-absent, 5-strong)	green: the aromatic associated with unprocessed vegetation, such as fruits and grains; this term is related to raw, but has the additional character of hexenals, leaves, and grass. grassy: grainy aromatic with some green character of freshly mowed grass (after cutting the grass).
hay (0-absent, 5-strong)	hay-like: the aromatic associated with air-dried grain or vegetation.
FRUITY	
cooked fruit pear/quince (marmalade) (0-absent, 5-strong)	aromas and taste that associated with cooked fruit - baked, jammy.
TASTE EVALUATION	
TEXTURE IN MOUTH	
viscosity (1-low, 5-high)	in everyday terms (and for fluids only), viscosity is "thickness". Thus, water is "thin", having a lower viscosity, while honey is "thick", having a higher viscosity.
FLAVOUR	
acid (0-absent, 5-strong)	the taste stimulated by acids, such as citric, malic, phosphoric, etc.
sweet (0-absent, 5-strong)	the taste stimulated by sucrose and other sugars, such as fructose, glucose, etc.
TASTE	
HERBACEOUS	herbaceous: General term (see also "vegetal") for a product with "green," "grassy" or "hay-like" aroma or flavor.
grass (0-absent, 5-strong)	green: the aromatic associated with unprocessed vegetation, such as fruits and grains; this term is related to raw, but has the additional character of hexenals, leaves, and grass. grassy: grainy aromatic with some green character of freshly mowed grass (after cutting the grass).
hay (0-absent, 5-strong)	hay-like: the aromatic associated with air-dried grain or vegetation.
FRUITY	
cooked fruit pear/quince (marmalade) (0-absent, 5-strong)	aromas and taste that associated with cooked fruit - baked, jammy.
raisins (0-absent, 5-strong)	aromatic associated with a grape of any of several varieties that has been dried in the sun or by artificial heat.
OTHERS SENSATIONS	
adstringent (0-absent, 5-strong)	the shrinking or puckering of the tongue surface caused by substances such as tannins.

Table 25 - Baobab Drink - References/Anchors.

	REFERENCES/ANCHORS	
APPEARANCE		
TURBIDITY (0-weak, 5-strong)	1 - water	5 - Baobab powder sample
VISCOSITY (1-low, 5-high)	1 - water	5 - Baobab powder sample
ODOUR EVALUATION		
ODOUR/SMELL		
HERBACEOUS		
grass (0-absent, 5-strong)	0 - water	5 - fresh herb, grass
hay (0-absent, 5-strong)	0 - water	5 - air-dried vegetation, hay
FRUITY		
cooked fruit pear/quince (ma	0 - water	5 - cooked fruit
TASTE EVALUATION		
TEXTURE IN MOUTH		
viscosity (1-low, 5-high)	1 - water	5 - Baobab powder sample
FLAVOUR		
acid (0-absent, 5-strong)	0 - water	5 - Baobab commercial juice sample
sweet (0-absent, 5-strong)	0 - water	5 - Esteval Syrup sample
TASTE		
HERBACEOUS		
grass (0-absent, 5-strong)	0 - water	5 - fresh herb, grass
hay (0-absent, 5-strong)	0 - water	5 - air-dried vegetation, hay
FRUITY		
cooked fruit pear/quince (ma		5 - cooked fruit
raisins (0-absent, 5-strong)	0 - water	5 - raisins (brand, grape variety)
OTHERS SENSATIONS		
adstringent (0-absent, 5-stro	0 - water	5 - Baobab powder sample

During consecutive training sessions, the panel was exposed to different Baobab samples and tried to identify all (or part of) the aforementioned attributes. Subsequently, the panel was presented with selected samples of Baobab and based on the list, they had to identify and quantify the main descriptors using a 0 to 5 continuous scale (100 mm) – in which 0 stands for none and 5 for strong. At each session, samples labelled with three digit random numbers and served in transparent plastic cups (50 mL), were present at each panellist monadically according to a balanced design. Mineral water was available for rinsing between samples.

Focus Group

In order to gain insights on consumer´s perception towards Baobab drinks, one small focus group was run in Porto (Portugal) during November (2012) with 9 recruited volunteers. All the participants in this study signed a consent form and an information sheet, ensuring confidentiality of information and voluntary participation.

The focus group was performed with an experienced moderator who besides the neutrality also promoted empathy within participants. The native language of participants was used and then the results translated to English. The focus group took place in a pleasant room, with a round table and a comfortable environment. All participants received a reward in order to thanks their participation.

Participants were selected when fulfilling the following requirements: a) Fruit juice consumers (at least twice a week) and b) Responsible for buying food stuffs (at least once a month). The characterization of participants is as follows as the Table below.

Table 26 –Focus group participant´s demographic profile

Demographics	Participants (%)
Male	44%
Female	56%
Age 25-50	100%
Single	44%
Married	56%
Higher degree education	55%
Secondary degree education	45%

A Focus Group script was developed based on state of the art on the methodology. The themes exploited in Focus Groups are presented in Table 27.

Table 27 – Theme on the Focus Groups script

Exploited Topics of Focus Groups
A. Global sensory characterization
B. Attitude to buy
C. Consumption occasion
D. Consumption Motives
E. Willingness to pay
F. Local to buy
G. Others possible usages of Baobab
H. Influence of African Origin on preference

The focus group discussion began with a global sensory characterization of Baobab in order to assess the impact of a first sensory experience on the acceptance of Baobab drinks. With that in mind, four blind different Baobab drink samples were tasted and

evaluated by participants, who were asked to do a global characterization of each sample, and to rank them by preference liking. The samples evaluated were:

Sample A – Commercial Juice "Esteval" (ready-to-drink)

Sample B – Commercial Syrup "Esteval"

Sample C – Commercial Syrup "Kumba"

Sample D – Traditional instantaneous powder (previously prepared with boiled water)

The focus group discussion were DVD recorded and all records were later transcripted verbatim to text, and contented analysed with software NVivo, to outline findings and meet research goals for this stage.

Figure 28 – Focus Group photography.

Consumer study

Participants were recruited considering their interest and availability to participate in the study. At recruitment stage, information about the specific aim of the study was provided.

Consumers (n=100) were interviewed at a public local shopping center using the central location method (Meilgaard et al., 2007).

Three Baobab drinks were selected for consumer tasting among the samples used for sensory analysis, namely:

1. Traditional boiled instantaneous powder
2. Commercial juice from Esteval
3. Commercial syrup from Kumba

Consumers were asked to score their overall liking, concerning global appreciation, appearance, smell and taste of each sample on a 9-point hedonic scale (1 = "dislike extremely, 9 = "like extremely"); sweetness of each product using the 9-point "Just About Right" (JAR scale) and their willingness to buy on a 5-point scale (1 = "certainly I would not buy", 5 = "Certainly I would buy"); and to answer a Check-All-That-Apply (CATA) questionnaire that included 29 sensory and emotional terms.

Consumers were asked to check all the terms they considered appropriate to describe each of the samples. The terms were selected based on previous studies (sensory evaluation and focus-group) published data and marketing campaigns of Baobab in African market. As shown in Table 29, the terms considered in the CATA question were grouped into two categories: sensory characteristics (n=17) and emotional associations (n=12).

Table 29 - List of attributes considered in CATA question.

SAMPLE			
APPERANCE			
Amber colour			
Salmon-pink colour			
Gold			
Turbid			
Viscous			
Fluid			
SMELL AND TASTE			
Sweet			
Acid			
Adstringent			
Green fruit			
Grass/Hay			
Marmalade/jelly			
Cooked fruit			
Pear nectar			
Raisins			
Caramel			
Guava			
SENSATIONS			
Natural			
Artificial			
Fresh			
Watery/Diluted			
Instantaneous			
Syrup/Concentrated			
Fibres			
Healthy			
Functional food			
Pleasant			
Unpleasant			
Tropical/Exotic			

Data analysis

An analysis of variance (ANOVA) was performed on sensory and consumer overall liking scores considering assessor and sample as fixed source of variation. Mean ratings and honestly significant differences were calculated using Tukey's test, and were considered significant when $p \leq 0.05$.

A principal component analysis (PCA) was also performed on the correlation matrix of the means of the trained assessors' data.

All records from focus group were later transcripted verbatim to text, and contented analysed with software NVivo.

In order to identify groups of consumers with similar preference patterns, a hierarchical cluster analysis was performed on overall liking data. Euclidean distances and Ward's aggregation method were considered.

For the CATA study, frequencies of mention for each word were determined by counting the number of consumers that used that word to describe each Baobab drink.
A multiple factor analysis (MFA) was performed on responses to the CATA question in order to identify relationships between the terms and the samples and to get a sensory map of the samples (Bécue-Bertaut and Pagès 2008). This analysis was performed on the frequency table that contained responses for each category of terms of the CATA question, considering consumer overall liking scores as supplementary variable. In this analysis, the different categories of terms from the CATA question were considered as separate groups of data to investigate the relationship between them.
Finally, external preference mapping was used to link consumer overall liking scores and responses to the CATA question. A density plot of consumer liking was created, identifying the percentage of consumers satisfied with samples.

All statistical analyses were performed using software NVivo, SPSS 19 and XLSTAT 2012.

Results and Discussion

Sensory evaluation

Qualitative Descriptive Analysis (QDA) was performed in order to establish a sensory profile of Baobab drinks (Figure 29). Highly significant differences (P<0,001) between the samples were found for all the evaluated sensory attributes.
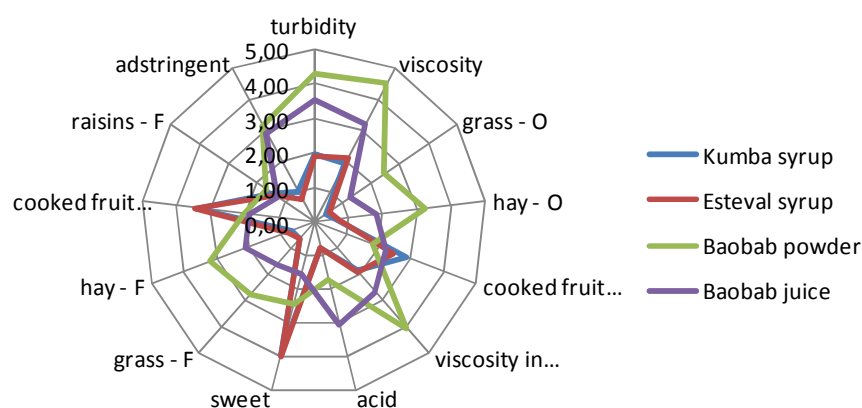

Figure 29 - Sensory profile (QDA) of Traditional boiled instantaneous powder; Commercial juice from Esteval; Commercial syrup from Esteval and Commercial syrup from Kumba.

Traditional boiled instantaneous powder is characterized by high turbidity and viscosity scores, grass, hay and astringent attributes. Commercial juice from Esteval is represented by high turbidity and viscosity levels (less than previous sample), acid and astringent descriptors.

Regarding Commercial syrups from Esteval and Kumba, both samples are described by their cooked fruit pear/quince (marmalade) and sweet sensory attributes.

Sensory profile of Traditional boiled powder is more complex then sensory profiles of Commercial juice from Esteval and from Commercial syrups from Esteval and Kumba. The later ones have the same sensory profile.

Principal component analysis (PCA) was performed to summarize the relationship between the sensory attributes and the Baobab drinks (Baobab powder, Baobab juice, Kumba syrup and Esteval syrup). The first two principal components (PCs) accounted for by 83,15 % and 15,45 % of the variance of the experimental data, respectively. As shown in Figure 30, the first PC was positively correlated to Baobab powder with viscosity, grass and hay attributes and to Baobab juice with acid and astringent descriptors. On the other hand, the second PC was related to sweet and cooked fruit pear/quince (marmalade) sensory attributes being associated with Kumba and Esteval Syrups.
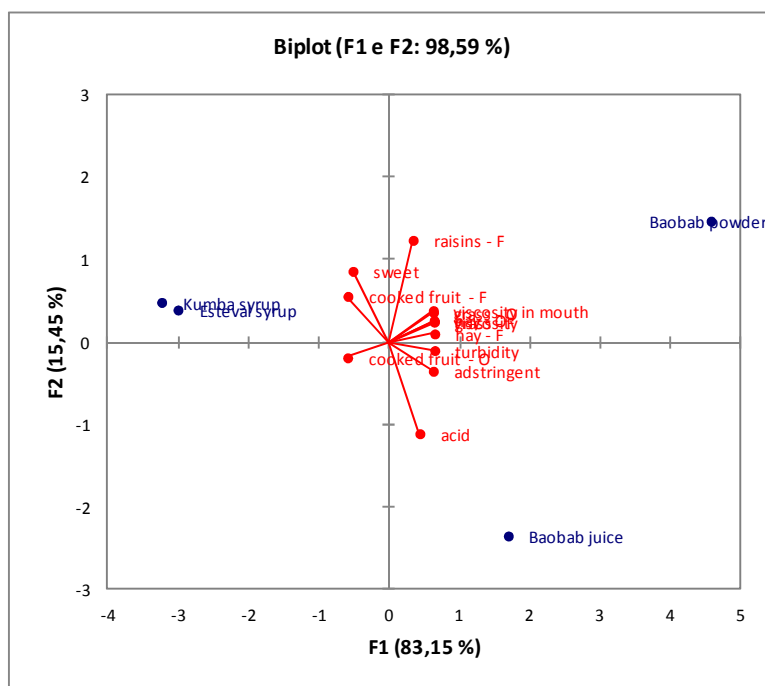

Figure 30 - Principal Component Analysis of trained assessor's sensory data (representation of sensory attributes and Baobab samples).

Focus Group

1. Global Characterization of Baobab Drink

Briefly is presented next a liking characterization based on the speech of the participants, after tasting and evaluating each sample:

Sample A – Commercial Juice from "Esteval" (ready to drink) – This was the most preferred sample selected by participants. This sample was valued because of its taste, although they think its bit acid.

Related to the aroma it was not highly appreciated, because they expected to be more fruity. They classified it as neutral aroma, not strong enough and dry, and what seemed like a vegetal aroma remembering straw. The colour does not also convince the participants because was colourless and slight.

Sample B – Commercial Syrup from "Esteval"– This sample, in general, was not appreciated by the participants, because it is too concentrated and too sweet. It was categorized like a sweet watery of cooked apple, and they think it should be stickier. The taste was associated to caramelized sugar and also to locust bean.

Sample C – Commercial Syrup from "Kumba" – This sample was also not very much appreciated by the participants, by the same reasons of sample B: too concentrated, too sweet, watery, tasteless and odourless.

Sample D – Traditional boiled instantaneous powder (no reference) – This sample was the second favourite of this group, but the texture should be indeed changed, otherwise they would not drink it at all. This sample had small pieces of seeds which participants are not used to and immediately rejected. The global appearance was similar to nectars, but still they think it should be improved. They expected a better aroma.

As presented on Table 30, regarding to the description of attributes generated two groups were elicited according to the positive and negative opinion of participants.

It was referred that in a general terms this drink is not yet suited for European kids and that is also do not suitable as a summer drink.

Table 30 –Attributes generated during the Focus Group

Sensory
Sweetness
Acid
Watery
Bitter
Food Related Positive
Apple
Pear
Caramel

Locust bean	
Fibre	
Peache	
Food Related Negative	
Animal Feed	
Non-Food Related Negative	
Syrup/Medication	
Straw	

2. Attitude to Buy

In this item it was evaluated the frequency of consumption if this beverage would be available on the Portuguese market. The answers show that participants are divided in four distinct groups: 33% would not buy this drink as it is in their original African form; 33 % would buy it 2 times/week; 23% would be willing to buy it once a week and 11% would buy it sporadic way, like 2 times in a month.

3. Occasion and Local for consumption

The Table 31 below summarize the main occasions and places for Baobab Drink consumption for Portuguese consumers.

Table 31 – Identified occasion and places for Baobab drink consumption

Occasion for consumption	Frequency (%)
Breakfast	55%
Middle of afternoon	33%
Any meal	11%
Locals for Consumption	
Home	33%
Outside (cafes, bars, restaurants)	78%

4. Motives for consumption

Healthy benefits are the main reason that might convince Portuguese consumers to buy Baobab Drink. This motive had 89% frequency, including participants stating they would not buy the product as it is now in its original form. Participants knew in advanced that Baobab has in its composition a high antioxidant capability mainly because of its high natural vitamin C content, which protects the cells of organisms from damage by free radicals (Gruenwald, 2005). So as this component is very important for human health they do not hesitate in drinking it even if the taste was not as pleasant as they expected. Besides the apparently low acceptability of same samples, taste (44%) and texture (33%) were also mentioned as important reasons that lead consumption. Novelty was also refereed (33%) but this motive has to be interpreted carefully once novelty works normally for first times of consumption.

5. Willingness to pay

Regarding willingness to pay for Baobab Drink, 44% of participants see themselves buying 1 L tetra-pack packages in supermarkets, and the range price varies between 1,00€-1,39€ / L.

Moreover, about 78% see themselves buying small packages of 0,33cl in cafes/bars, where they would be willing to pay between 0,85€-1,5€/package. The preferred material for the small package is glass (44%), tetra-pack and plastic were also referred (11%), but cans were not mentioned for this type of drink as preferred to.

6. Locals to Buy

Consists on locals where consumers would like to have Baobab drink available to buy, about 67% said in cafes and bars; supermarkets are mentioned in second place (56%); also restaurants were refereed but with a lower percentage (33%). In addition, convenience shops, gas station shops and delicatessen shops where also referred each one representing 11% of frequency.

7. Possible applications

The Table 32 below resume the frequency and applications proposed by the participants. The suggestions presented were aggregated in two distinct groups according the application´s type.

Table 32 – Possible uses for product type of Baobab

Applications Type	Product Suggestion	Frequency
Agro-Industries	Yogurt (liquid or with cereals)	44%
	Cookies	22%

	Cereal Bars	11%
	Soya Drink	11%
House maid	Jelly	33 %
	Fruit Tart	11 %

8. Influence of the origin

Concerning the importance and influence to consumers' choice of drinks origin´s in labelling, it seems that for the majority of the participants (56%) these agreement it might be very positive the mention "African Origin" in the label, adding value to the product and also curiosity to the consumers, to taste a product from such a different culture.

Consumer study

1. Consumer Overall liking scores

As shown in Table 33, there were not significant differences (P>0,05) in the overall liking scores. Regarding all samples used during consumer study it was possible to verify that all of the drinks were on the acceptable range since the mean scores were between 6 (like moderately) and 7 (like slightly). Baobab juice was the most preferred followed by Kumba syrup and Baobab powder, in a decrease order of magnitude.

Table 33 - Mean overall acceptability scores for the Baobab drinks tested.

Samples	Average	Groups [*]
Sample A - Baobab Juice	6,530	A
Sample B - Kumba syrup	6,490	A
Sample C - Baobab Powder	6,050	A

* Means with the same letter are not significantly different

2. Consumers segmentation using Hierarchical cluster analysis

The hierarchical cluster analysis (Ward method) identified three groups of consumers that scored the overall liking scores of the samples differently: Cluster 1 with 38 individuals, Cluster 2 with 48 and Cluster 3 with 14 consumers (Figure 31).
There were significant differences (P < 0.001) in the overall liking of the clusters, indicating different preference patterns (Table 34). Consumers in Cluster 1 gave the highest overall acceptability scores to Kumba syrup sample followed by Baobab juice and Baobab powder; Cluster 2 evaluated with highest scores Baobab powder followed by Baobab juice and Kumba syrup; and Cluster 3 attributed the highest scores to Kumba syrup sample followed by Baobab juice and Baobab powder.
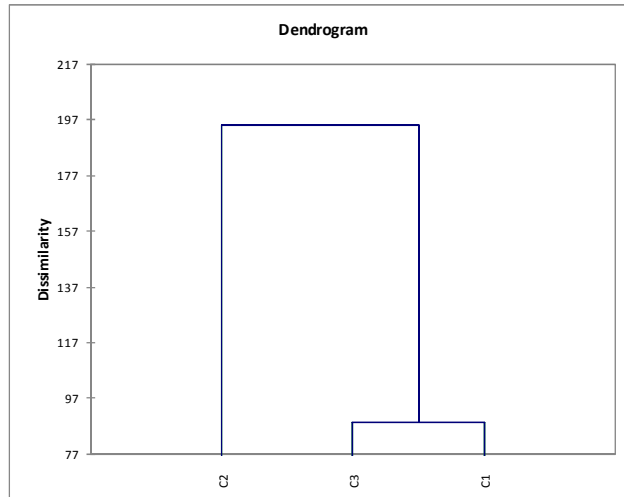
75

Figure 31 - Hierarchical cluster analysis of Baobab drinks consumers.

Table 34 - Baobab samples distributed into Cluster sorted by increasing order of preference.

Objects sorted by increasing order of preference

Cluster 1	Cluster 2	Cluster 3
Sample C - Powder	Sample B - Kumba syrup	Sample C - Powder
Sample A - Juice	Sample A - Juice	Sample A - Juice
Sample B - Kumba syrup	Sample C - Powder	Sample B - Kumba syrup

3. Check-All-That-Apply Question

Consumers were asked to evaluate the samples and to check all the terms that they considered appropriate to describe the sensory characteristics and emotional associations/perceptions using a questionnaire comprising 29 related terms. The most frequently selected terms were considered as the most used by consumers to describe the samples.

Table 35 shows the frequency in which each of the terms of the CATA question was used to describe the evaluated samples. The most frequently used terms were "sweet", "natural", "enjoyable/pleasant", "healthy", "tropical/exotic", "turbid", "amber colour", "marmalade/jelly", "pear nectar", "salmon-pink colour" and "fresh". Meanwhile, the least used terms were "caramel", "raisins" and "grass/hay".

Significant differences (P<0,0001) were found in the number of terms used by consumers to describe the samples. As shown in Table 35, the largest number of terms was used to describe Samples C - Baobab powder, B - Kumba syrup followed by A - Baobab juice. This could be explained considering that consumers were more motivated/interested to describe the samples that they considered more complex, it means, samples with a wide range/bouquet of words to describe the moment of tasting. Regarding the different categories in the CATA question, consumers used the terms related to the sensory characteristics of samples with a higher frequency than those within the emotional associations; suggesting that consumers' perception was mostly centred in their sensory characteristics.

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These results suggest that this type of question was able to detect differences in consumer's perception of the Baobab drinks.

Table 35 - Results of the Check-All-That-Apply question. Frequencies for each attribute and evaluated Baobab samples.

Category	Attributes	Sample A - Juice	Sample B - Kumba syrup	Sample C - Powder	Frequency of mention	Frequency of mention/category	Average number of mentions/category
Sensory Attributes/ characteristics	Amber colour	36	25	27	88		
	Salmon-pink colour	43	8	30	81		
	Gold	6	48	2	56		
	Turbid	37	11	42	90		
	Viscous	10	2	70	82		
	Fluid	11	66	2	79		
	Sweet	26	86	31	143		
	Acid	42	5	24	71		
	Adstringent	17	7	28	52	1160	11,6
	Green fruit	21	11	17	49		
	Grass/Hay	13	3	19	35		
	Marmalade/jelly	27	25	36	88		
	Cooked fruit	18	25	29	72		
	Pear nectar	13	14	55	82		
	Raisins	5	8	11	24		
	Caramel	4	12	4	20		
	Guava	14	17	17	48		
Emotional associations /Perceptions	Natural	42	22	63	127		
	Artificial	19	44	12	75		
	Fresh	20	40	21	81		
	Watery/Diluted	9	51	3	63		
	Instantaneous	10	27	4	41		
	Syrup/Concentrated	21	20	30	71	956	9,56
	Fibres	11	1	58	70		
	Healthy	34	19	52	105		
	Functional food	21	12	31	64		
	Enjoyable/Pleasant	35	41	39	115		
	Unpleasant	12	18	18	48		
	Tropical/Exotic	31	23	42	96		
	Total terms/sample	608	691	817			
	Average number of terms used in CATA question/sample	6,08	6,91	8,17			

Considering that the two identified clusters showed different preference patterns, they could have also used the terms of CATA question differently. Therefore, Multiple Factor Analysis (MFA) was carried on out considering CATA counts for both groups of consumers. Multiple factor analysis (MFA) was performed on responses in each category of the CATA question in order to identify relationships between the terms and the samples and to get a sensory map of the samples.

In what concerns sensory characteristics category, the first two dimensions of the MFA accounted for 100% of the variance of the experimental data; representing 62,92% and 27,08% of the variance for the first and second dimension, respectively. Regarding emotional associations category, the first two dimensions of the MFA accounted for 100% of the variance of the experimental data; representing 77,31% and 22,69% of the variance for the first and second dimension, respectively.

Figure 32 a) shows the representation of the sensory terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was positively correlated to terms gold, fluid, caramel and sweet related to sample B - Kumba syrup; and negatively associated to pear nectar, marmalade/jelly, viscous and raisins attributes represented by sample C - Baobab powder; and negatively correlated to amber colour and acid attributes related to sample A - Baobab juice. On the other hand, the second dimension was positively correlated to sweet, fruity and fresh herb representative of syrup sample.

Figure 32 b) shows the representation of emotional associations terms from the CATA question in the first and second dimensions of the MFA of CATA counts. The first dimension of the MFA was positively correlated to syrup/concentrated, fibres, natural, healthy, functional food and tropical/exotic terms being associated with sample C - Baobab powder; and negatively correlated to artificial, fresh, watery/diluted and instantaneous descriptors from sample B - Kumba syrup. Sample A - Baobab juice was positively represented in the first dimension of the MFA with no terms associated. Nevertheless, Sample A - Baobab juice maybe represented with enjoyable/pleasant and tropical/exotic terms.

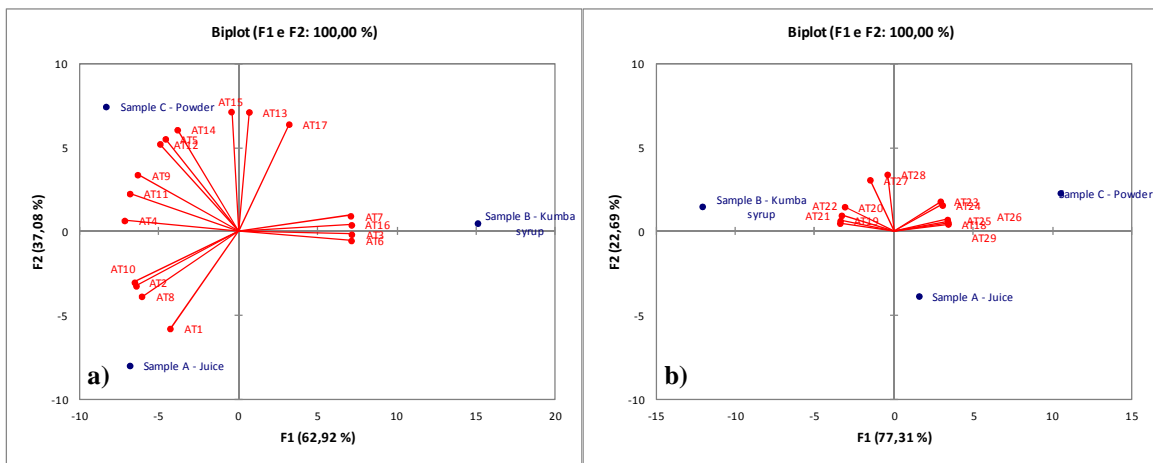| Attributes	
Amber colour	AT1
Salmon-pink colour	AT2
Gold	AT3
Turbid	AT4
Viscous	AT5
Fluid	AT6
Sweet	AT7
Acid	AT8
Adstringent	AT9
Green fruit	AT10
Grass/Hay	AT11
Marmalade/jelly	AT12
Cooked fruit	AT13
Pear nectar	AT14
Raisins	AT15
Caramel	AT16
Guava	AT17
Natural	AT18
Artificial	AT19
Fresh	AT20
Watery/Diluted	AT21
Instantaneous	AT22
Syrup/Concentrated	AT23
Fibres	AT24
Healthy	AT25
Functional food	AT26
Enjoyable/Pleasant	AT27
Unpleasant	AT28
Tropical/Exotic	AT29

Figure 32 - Multiple Factor Analysis on the Check-All-That-Apply questions a) representation of the attributes for sensory characteristics category and b) representation of the attributes for emotional association category.

Since different categories of terms were included in the CATA question, samples were characterized not only in terms of sensory attributes, but also considering consumer perception of different aspects of the samples (emotional associations) and the overall liking of each one. The relationship between the categories of terms from the CATA question provided interesting information. As shown in Figure 33, all the categories were located close to each other in the first dimension of the MFA, which suggests that they provided similar information. MFA accounted for 100% of the total variance of the experimental data; representing 67,59% and 32,41% of the variance for the first and second dimension, respectively. However, it is interesting to note that the group of terms related to emotional associations (sensations/perceptions) and the overall liking were highly correlated. This suggests that sensations/perceptions during degustation seemed to have influenced consumers' overall liking responses to Baobab drinks. Moreover, these two groups of terms were highly correlated to sensory properties; suggesting that sensory characteristics were the main determinants of consumers' hedonic and emotional response toward the evaluated Baobab drinks.
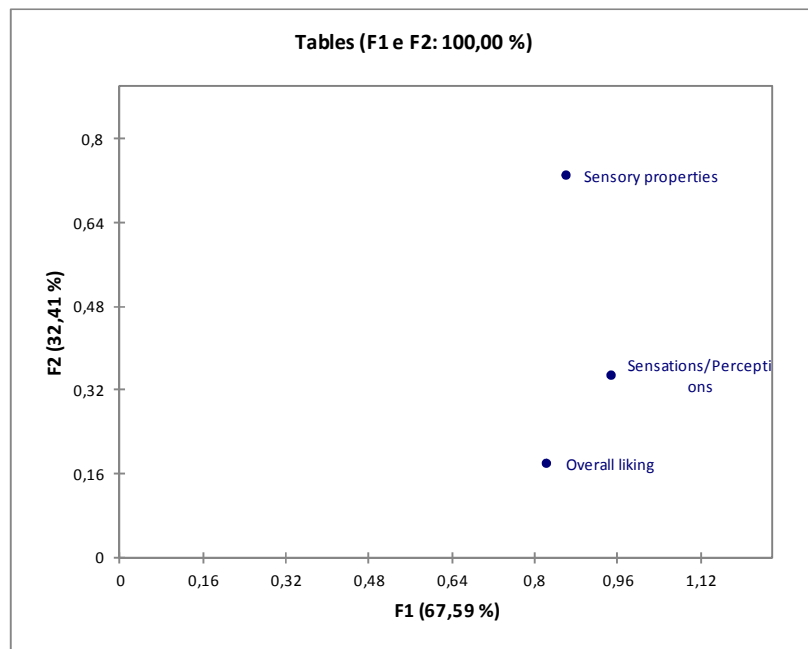

Figure 33 - Representation of the categories of terms from the CATA question and the overall liking scores in the first two dimensions of the MFA.

The approach of considering different categories of terms in a CATA question seems promising for studying the relationship of consumers' perception of sensory and non-sensory attributes of products. This is an interesting approach for R&D, Marketing and Communication departments to develop strategies for launching a new/or changed product to market. So, to more finely compare the level of agreement/disagreement between all categories considered on CATA question and overall liking scores, MFA was employed using the first two dimensions of the three maps created. Figure 34

represents the location of the Baobab drinks as optimal product determined for each of the three types of categories on the first two MFA factors (individual factor map).
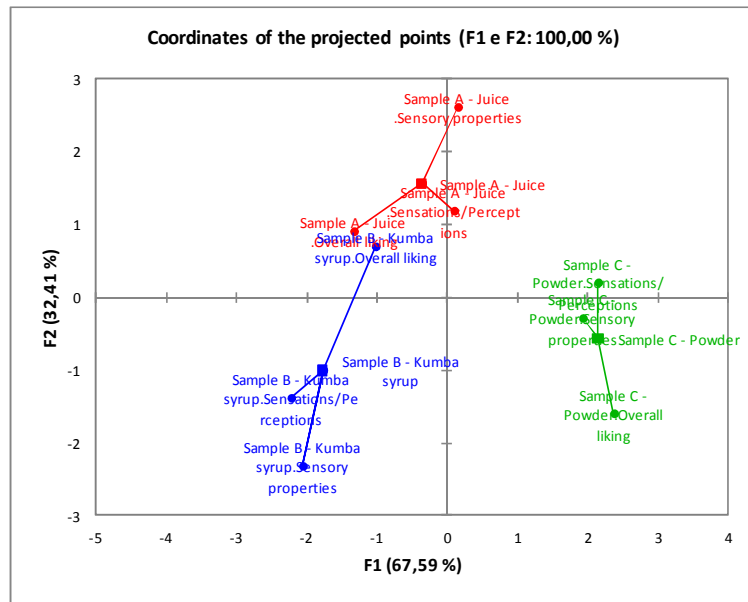

Figure 34 - Products' spatial representation /products' configuration (first two dimensions) determined using sensory characteristics, emotional associations and overall liking scores of consumers.

4. External Preference Mapping

External preference map (and contour plot) based on samples' configuration in the MFA of CATA counts was impossible to perform since it is need more observations (individuals). As mentioned in section "consumer overall liking scores", there were not significant differences (P>0,05) in the overall liking scores of presented samples.

In this way, it was only possible to determine the percentage of individuals satisfied for each sample (Table 35).

Table 35 - Percentage of consumers satisfied for each sample.

Samples	%
Sample A - Juice	67%
Sample B - Kumba syrup	67%
Sample C - Powder	33%

5. Internal Preference Mapping

Figure 35 shows the internal preference map based on consumers' overall liking of Baobab drinks.

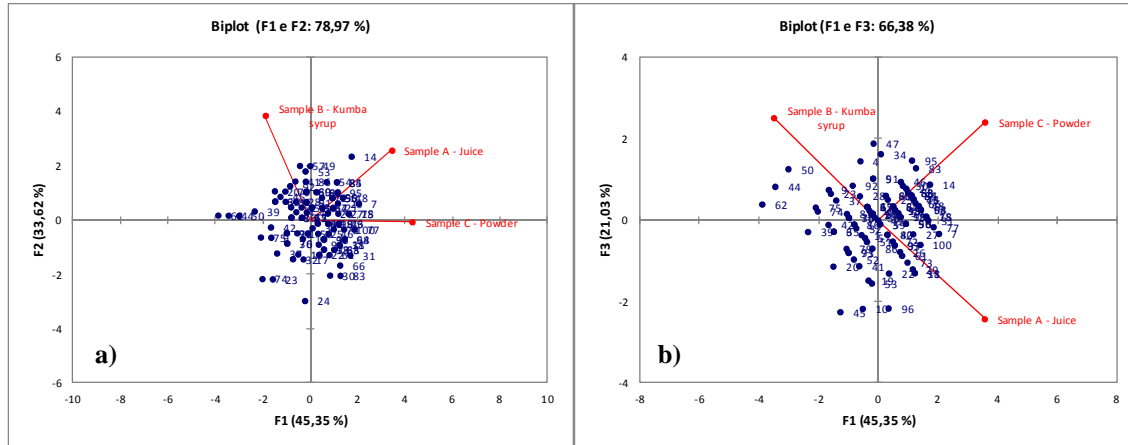|	Consumers	
Sample C	30	30%
sample B	27	27%
Sample A	22	22%
no opinion	21	21%
	100	

Figure 35 - Internal Preference Map based on consumers' overall liking samples.

The internal preference map showed four groups of consumer's preference: Group I - sample C - Baobab powder with 30%, Group II – Sample B - Kumba syrup with 27%, Group III – Sample A - Baobab juice with 22% and Group IV with no opinion with 21%, of overall liking scores.

Conclusions

Unfamiliarity with respect to taste of Baobab, the first global perception implies that the product needs reengineering to be adapted to the Portuguese market, especially regarding to the texture and aroma attributes.

Sample configuration from consumers' CATA counts and trained assessors data were similar, suggesting a good agreement between both evaluations. The use of CATA questions could be a simple way to perform external preference mapping when a sensory trained panel is not available or when there is not enough time to train a sensory panel. In this way, the use of the CATA question could consist on a complementary technique to traditional preference mapping.

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