Paper 13

A sensory approach to consumers preferences for Rice : First results of a European survey (France, Greece, Netherlands, Spain)

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Abstract

Surveys on rice consumption in Europe suggest that levels of consumptions as well as preference patterns are different in each country. It is hypothesised in marketing research that preference patterns may be a function of cultural and social factors (such as situations of usage, attitudes toward cooking), individual factors (socio-demographic characteristics, involvement and expertise in food , innovativeness, brand sensitivity...) and product attributes. Among these attributes, the sensory dimensions are paramount (aspect, texture, flavour), but they are seldom included in marketing experiments because of the difficulties encountered in « objectivating » consumer assessments. Other attributes are important : some are related to services attached to the product (easy cooking, packaging), others are more related to images (brands, origin of product).

The objective of this research is to compare various criteria used by customers to evaluate the quality of

rice, at two stages : Raw rice (as it appears usually in transparent packages) and cooked rice, in blind conditions (i.e. without the cues on the packaging).

750 customers are surveyed in 5 countries : France, Greece, Netherlands, Spain, UK. Half of them have been asked to taste 6 different rices (raw and cooked). The same experimental procedures have been used in each country. These rices have been previously selected and characterized through sensory analysis and laboratory measurement in a parallel research program, in order to select as different rices as possible.

This paper presents first results on 4 countries : France, Greece, Netherlands, and Spain (556 respondents).

General preference for raw and cooked rice is graded from 1 to 10 by the respondents. Through various statistical procedures, preference is then related to attitudinal and behavioural factors, as well as personal demographics in order to detect crosscultural differences in preference patterns.

Our first results show that there are indeed national differences in rice evaluation. For instance, parboiled rices seem better appreciated by the Greeks and the French than by the Dutch respondents. Individual criteria (age, sex, revenue, habits of cooking) seem to have little influence on sensorial preference. In terms of marketing management, these first results suggest that branding policies are relevant to help consumer choose for quality.

Keywords

- Rice, Marketing, Consumer preference
- France, Greece, Netherlands, Spain, UK

Introduction

The consumer approach to rice quality is part of the European research program « Quality and Competitiveness of European Rices » Concerted Action in 1995. Its objectives and methods have been discussed at the Arles meeting, then at later meetings in Montpellier (nov.1996, June 1997). Eight research teams and a major firm producing rice in France have been involved at different stages of the research program**.

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The overall objective of the program is to obtain insights on the perception and evaluation of rice quality by the European consumer. Ultimately, the focus is put on the relations that may be found between rice characterisation of quality through laboratory measurements, sensory trained groups evaluations, and

untrained consumer preferences. Factors that may explain preferences (and particularly cultural ones) should also be identified.

In order to achieve these objectives, two projects have been developed. The first one, carried at the Theix INRA research center under the name of THEIX-SAVE-RIZ, was in charge of selecting rices that could be considered as typical for European consumers (that is, as different as possible) and then used for consumer tasting experiments later on. These rices were to be characterized by laboratory measurement and sensory analysis by specially trained groups. This procedure led to the selection of 6 among 26 different rices.

In the second project called « EURICE », « naïve » consumers were asked to express their preferences about these rices selected by the THEIX-SAVE-RIZ team, and provide informations that would help explain these preferences. The EURICE project contains three steps : In the first one, a qualitative research was done in six countries, using the focus group approach in order to collect exhaustive data on consumer behaviours and attitude towards rice, including sensory reaction to cooked rices, as well as semantics attached to these evaluations. In the second one , an experimental design in 5 countries allowed to collect actual preference on cooked and raw rice from rice consumers. In the third part of the project, which will start early 1998, we will collect data on rice consumption and preferences in 80 households, in France and in the UK., during a 12 weeks period.

At the time of this presentation, the program has not been entirely completed. All countries involved have not yet finished the experiments of step 2, and the last part of the program -a follow up of 80 households in two countries- has not yet taken place.

Therefore, this paper presents a synthetic view of the results obtained so far by the participants of the EURICE program. In the first part, we point out the aims, and the methods adopted for the focus group approach and summarise some of the results obtained by the 6 research teams. In the second part, we analyse and discuss the data collected through the tasting and questionnaire experiment in 3 countries : France, Greece and Holland. We have chosen to focus our analysis on the variables that may best explain hedonic rice preferences : raw rice evaluation, semantics associated with rices, personal characteristics of respondents.

The focus group approach to explore consumer preferences and attitudes towards rice

The focus group approach is frequently used in marketing research in order to collect exhaustive information about consumer evoked sets** about a product. The samples are small (8 to 15 people) in order to facilitate individual and group expression. The choice of respondents is defined in order to obtain diversity and avoid sub groups clusters. Discussions are monitored according to a grid followed by the leader of the session. The discussions are recorded and a silent observer takes notes on reactions and attitudes during the experiment, that lasts about 1 and ½ hour.

> **Evoked set refers at the group of products that are considered as relevant and substituable in the consumers mind when he is in a choice situation. Consumption situations and images related to these situations influence this evoked set.

The focus group sessions consisted in two parts. A general discussion about rice was followed by a blind test of 4 to 5 rices (cooked, then uncooked). For the discussion, a common grid was used by all research teams, in order to collect information on what people know, believe and feel about rice, different sorts of rices and their context of usage. For the tasting part, each team was free to choose local rices. However, we recommended to include at least one savoury type of rice (such as basmati), a parboiled rice, a white rice and a brown rice. The purpose of the test was to collect semantics about rice evaluations relating to appearance, odour, savour, texture. An other objective was to test the ability of the consumers to relate raw and cooked rice quality.

The results of these focus groups have been published recently**. We will therefore limit ourselves to the

more meaningful findings, concerning spontaneous judgements on rice in general, on the different types of rices, and on sensory evaluations.

**D'Hauteville François, 1997, « The quality of Rice : A synthetic analysis of six reports : France, Greece, Italy, Portugal, Spain, United Kingdom ». Cahiers Mediterranéens, vol 24, 13-21.

Opinions about rice in general

All respondents suggest that rice is a universal and staple product, both for ordinary or special occasions. There seem to be however a "generation effect " on this opinion. In France and in the UK at least, rice is still a "new product" for older generations, but is seen as a basic product for younger ones.

As a whole, it appears also that rice is a differentiated product, spontaneously associated with production areas : exotic areas for the French, the Greek and the Britons, more associated to local production and dishes for the Spaniards and the Italians.

Rice is also considered by all the respondents as a healthy product in a broad sense : it is an appropriate dish when one has stomach problems, it is energetic and contains vitamins, it is recommended when one indulges in athletic activities.

The taste of rice is quoted as the most desirable property of rice in Spain and Greece. On the other hand, British respondents insist principally on texture and aspect (fluffy). They tend to have also more pragmatic view on rice : it is practical and handy, you can use the left over (which is an advantage on pasta and potatoes). This is also true for Portuguese respondents, who think of an "ideal" rice as a non sticky, white, with unbroken grains. French respondents are sensible to the variety of tastes that are offered, which may be the result of recent advertising campaigns on this thema.

There are only few spontaneous reasons for dislikes : most reasons behind restrictive opinions about rice are linked to cooking problems. Some French respondents associate starch with health problems, others mention that choosing rice on the shelf is difficult because of the width of the range of rices offered at point of sale.

Although this aspect has been developed only in the British and French surveys, it appears that many respondents think that a few minutes difference in cooking time is not very important, and others do not trust anyway the time indicated on the packs (British respondents tend to think that cooking times on instructions are too long). This may be an interesting area of investigation as the manufacturers tend to improve the cooking time performance as part of the service offered to the customer.

Rinsing the rice seems also an issue, as well as cooking in cold or boiling water.

Opinions about the different types of rices

As a whole, product positioning of the different varieties of rice are quite similar across the focus groups. Plain long rice is considered as the best rice, whereas parboiled rice is associated with industrial processing and therefore is less considered. The yellowish colour is apparently less appreciated than a plain white colour. Long grain rice is considered as non sticky (provided that it is not over cooked) .

Round rice is considered as a lesser quality product, dedicated to puddings or desserts. Only the Spaniard group consider it as the most tasty type of rice. Brown rice is not well known, and perceived as a speciality, diet product. Its appearance is not well judged. British respondents seem to have a better opinion of brown rice than the other groups.
It is also interesting to note that respondents tend to consider native rices as good quality rices (France, Greece, Spain, Italy).

Sensory evaluations of rice

Globally, it is interesting to note that, when it has been tested, Basmati rice is very well rated even among people who are not used to it. This is notably the case in the Portuguese and the Greek groups. In the latter, the distribution of basmati preference seems bi-modal, one sub group being enthusiastic whereas the other rejects the taste as being artificial . Brown rice is also subject to a bi-modal evaluation by most of the national groups. In general, brown rice receives more negative evaluations than other rices on aspect, texture or even

smell, whereas for all other rices, the number of positive comments is higher than the negative ones.

In all test groups, it seems that familiar rices such as plain long or semi long rice receive positive evaluations. In France, long parboiled rice seems very well rated, in contrast with other countries.

Beyond the comparative analysis of rices between the national groups, it is interesting to see how the sensory experience is performed, and how general preference is consistent with the 4 sensory dimensions (aspect, texture, odour, savour)

First, there seem to be some consistency between visual evaluation of uncooked rice and evaluation of cooked rice. This conclusion derives from the UK and the French groups. The UK report shows that the profile curve is comparable between cooked rice and uncooked rice (UK report, fig.1 and fig 2), except for an inversion on colour, smell and texture for long grain parboiled and brown Basmati. In the French experience, the ranking of preference is comparable between cooked rice and uncooked rice, except for the second group where brown rice comes from bottom to first ranking between the two tests. This suggests that appearance of raw rice may be is a quite correct indicator of rice quality for most respondents, which means that customer experience of rice plays a direct role in the process of quality judgement.

Looking again at UK results, it appears that the sensory dimensions are quite correlated with each other and with the global preference. The sensory profiles of the 4 rices tested tend to be homogeneous on each dimension. This result would confirm the general opinion among researchers that untrained consumers are not really able to dissociate the constituents of their global preference.

Supporting these finding is the relatively small number of descriptors spontaneously used by the consumers when they are asked to describe their sensations. For the French group, this is particularly true for smell or taste descriptors. Most descriptors are in fact intensity measures of preference (very good, neutral or tasteless, poor), some of them being a comparative judgement with the previous sample. Out of a total of over 50 judgements, 6 words only can be considered as descriptors for odour, 3 for taste, 12 for texture and 13 for appearance. Obviously, aspect and texture are easier to describe than smell or taste. It should be also noted that some descriptors are used indifferently by some respondents for smell and taste, or for texture and aspect.

If we look at the Portuguese results, where respondents were proposed a choice of descriptors, it appears that the descriptors that are most used are those who express preference (pleasant/unpleasant, well/badly shaped) whereas informative descriptors (salty, bitter, straw taste, musty, carrot or corn flavour) are seldom selected by the respondents.

Conclusions from the focus group research

Spontaneous expression about what people know, like or dislike about rice in general, suggest that national differences on these points are not fundamentally different.

Globally, product evaluation of rices tend to be similar in each country : When it is tested, people rate Basmati rice high, as well as the rice they are used to. Brown rice is generally little known and appreciated, with a diet image. Round rice (or semi-long rice) is not rated as well as long rice.

The sensory evaluation process seems to be quite global. The results suggest that the rating of quality descriptors may be co-related, showing that consumers have difficulties to dissociate the components of their global preference. As expected, the semantics used spontaneously by the respondents express a level of satisfaction rather than a description of sensations. The extent of this difficulty will be measured in the questionnaire

Interestingly, most respondents seem to relate consistently visual quality of uncooked rice with quality after tasting the rice, which suggest that consumer have a good experience of the product. This should be confirmed by further experimentation, particularly by associating rice purchase/consumption experience with the consistency of evaluation between uncooked and cooked rice.

Measuring and explaining consumers preference : an experimental approach

Experimental design

The second step of the research consisted in an experiment on a minimum sample of 150 consumers in 5 countries (France, Greece, Netherlands, Spain, UK). Results are presented here for France (n= 155), Greece (n=150) and Netherlands (n=160). Based on the focus group results, the experimental design was as follows :

Half of the sample (Group A, 75 to 80 persons) was invited to a tasting session of the six rices selected and cooked according to standard procedures defined in the THEIX SAVE RIZ project (quality of water, amount of salt, cooking time). They were presented to each respondent in random order on a tray with a device to keep the rice samples warm during the tasting session. Each rice was identified with a double set of random number, the same for all countries : one for the cooked rice evaluation, one for the raw rice. The respondents were free to compare the rices before evaluating them. A first questionnaire (Questionnaire A) was designed to measure preference on a 10 points evaluation scale and attitudes towards each rice a group on a 7 points semantic scales. Respondents were invited to provided free judgements on each rice, using both positive/negative descriptors, and they could give an opinion on the adequation of each rice to different eating situations. This group A was also given the questionnaire designed for group B (below). The whole procedure lasted about 90 minutes.

The second half (Group B, n = 75 to 80) was given only the questionnaire B, through a face to face procedure at the respondents home (fig.1)

Figure 1. Rice preference experimental design and measures

	Questionnaire A	Questionnaire B
Group A n= 240 France n= 85 Greece n= 75 NL n= 80	Preference on cooked rice Semantic scales cooked rices Adequation cooked rices Spontaneous pos/neg. descriptors	Uncooked rice preference Psychometric scales Attitude and product attribute scales Consumption, purchase, cooking Personal characteristics Adequation of rice, eating situations
Group B n = 235 France n= 80 Greece n= 75 NL n= 80		Uncooked rice preference Psychometric scales Attitude and product attribute scales Consumption, purchase, cooking Personal characteristics Adequation of rice, eating situations

This questionnaire contained the following items :

- An evaluation of uncooked rices (the six rices were presented to the respondents in transparent bottles identified by random numbers different from those used on the cooked rices)
- A collection of 38 five point attitude scales ranging from « completely disagree » to « completely agree », corresponding to personality traits frequently used in marketing research in relation to eating, cooking, and rice in general. It was hypothesized that these scales would help identify cultural differences among the samples.
- Opinions about rice in general and the different types of rice on the market
- Opinions about rice adequation to eating or cooking situations and dishes, in comparison with alternative products (such as potatoes or pasta)
- Eating and purchasing habits and opinions .about rice
- Sensibility to time of cooking
- Personal characteristics of the respondents.

Sample characteristics

Sample characteristics are described in table 1.

Table 1. Characteristics of samples

		France n = 155		Greece n = 150		Netherlands n = 160		Total n=465		Test χ2
		n	%	n	%	n	%	n	%	
Sex	Male	52	33.5	28	18.7	73	45.6	153	32.9	.0000
	Female	103	66.5	122	81.3	87	54.4	312	97.1	
Age	18-24	44	28.3	19	12.7	61	38.1	124	26.7	.0000
	25-35	33	21.3	60	40.0	33	20.6	126	27.2	
	36-44	23	14.8	26	17.3	26	16.2	75	16.2	
	45-60	38	24.5	18	12.0	32	20.0	88	19.0	
	60 +	17	10.9	27	18.0	7	4.0	51	11.0	
Household size	1 pers.	23	15.3	17	11.3	26	16.2	66	14.3	.0000
	2 pers.	48	31.0	24	9.3	19	11.9	91	19.7	
	3 pers.	34	21.9	32	21.3	27	16.9	93	20.1	
	4 pers.	36	23.2	49	32.7	44	27.5	129	27.9	
	5 pers.	10	6.0	17	11.3	7	4.4	34	7.3	
	6 pers.	3	1.9	11	7.3	36	22.5	50	10.8	
Revenue	low	44	28.4	73	48.7	39	24.4	156	40.0	
	medium-low	61	39.2	28	18.7	21	13.1	110	28.2	
	medium high	26	16.8	5	3.3	20	12.5	51	13.1	
	high	14	9.0	5	3.3	54	33.7	73	18.7	
Cooking freq.	most often	102	65.8	102		73	45.6	277	59.8	.0000
	occas.	48	31.0	31		80	50.0	159	34.3	
	never	5	3.0	17		5	3.1	27	5.8	
Test group	A (taste rice)	84	52.3	80	53.3	80	50.0	244	52.5	.7331
	B(do not taste	71	45.8	70	46.7	80	17.2	221	47.5	

The purpose of the research was not to forecast rice consumption, but to identify causal factors of preference. Thus, the sample of respondents had no ambition of being representative of the population. Therefore, each local research team may have used its own way of choosing the sample of respondents, provided that they include in their samples a representation as large as possible of the different characteristics that may be related to food consumption in general (age, sex, revenue, size of family). Respondents were selected on existing lists and through recruiting ads in newspapers. As a result, table 1 show that sample structures are quite different from one country to another.

Results of the experimental approach and discussion

Sample characteristics and sensory evaluation of cooked rice

Because of these differences of sample characteristics, it is necessary to control the effects of sample characteristics in our experiment. We have tested the preference scores of cooked and uncooked rice related to these variables through a serie of variance analysis shown on table 2.

Table 2. A variance analysis to test the relation between preference of cooked/ uncooked rice and characteristics of respondents : values of probability tests

Var. name	Type of rice	sex	age (all) a	age (under 60) a	size of household a	revenu of household a	Cooking freq. a	Country* b
PREF020	Basmati	.1826	.0026	.1168	.4281	.4633	.4926	.0000
PREF035	U.Bens (P)	.0350	.0002	.0115	.8890	.6141	.1684	.0000
PREF305	TBS17'(P)	.3034	.0015	.4026	.1053	.0451	.0085	.0000
PREF586	TBN10'(P)	.0223	.0036	.1042	.0324	.7462	.6634	.0006
PREF785	TBC15'	.6526	.0088	.5953	.2158	.1553	.1717	.0065
PREF801	Ariete	.0849	.0082	.8398	.2671	.6314	.0286	.0000
RAW369	TBS (P)	.0165	.0020	.0015	.1121	.5429	.0369	.0019
RAW397	Basmati	.8096	.1379	.1579	.7198	.5341	.8263	.0920
RAW442	TBN (P)	.0030	.0001	.0001	.0959	.6805	.0100	.0000
RAW457	U.Bens (P)	.0686	.0184	.0093	.1764	.7619	.0182	.0850
RAW538	TBC	.0931	.8361	.8613	.2242	.0309	.9562	.0002
RAW877	Ariete	.0976	.2743	.4849	.0164	.5682	.4823	.0000

a = F probability test of the variance analysis
b= Chi-Square Kruscal Wallis Anova test
* age group over 60 not included.

Table 2 shows that the age of respondents is the only variable that seems to be related to preference for cooked rices (column « Age, all »).
If we look into the data, it appears that the « 60 and over » group of age tends to grade all rices systematically higher than the other groups. The range of scores varies between 4 to 10, whereas other groups use the full scale of grades from 1 to 10. An analysis of variance excluding this 60 years over class of age show that age is not related to cooked rice preference for all other age groups (table2, col. « under 60 »).

Because the proportion of age groups are different among samples, we may find differences of preferences by countries due to this factor. Therefore we will decide to conduct our cross cultural analysis excluding this age group.

Sample characteristics and sensory evaluation of uncooked rice

The relations between sample characteristics and raw rice evaluation may not be considered as statistically significant if we look at the values of F probabilities, except for the age variable. Indeed, if we look into the data, it appears that the younger prefer white plain rice, whereas the older give a better score to yellowish parboiled rices. For the other factors, there seem to be a systematic difference of evaluation between parboiled and plain rices according to sex and cooking frequency, but it is not supported by solid statistical evidence.

Experimental design and sensory evaluation of rice preference

An experimental bias may have been introduced in the evaluation of the uncooked rice. As recalled earlier, the A group was exposed to the tasting of cooked rice in experimental surroundings, prior to the exposition to the questionnaire B including evaluation of uncooked rice. The B group was exposed only to the questionnaire B with the uncooked rice evaluation.
Moreover, B respondents were interviewed at home, thus in a different experimental context.

A variance analysis relating preference to test groups show that the Fisher test proves insignificant for the 3 parboiled rices. The level of significance of the F test is not very high for the 3 white rices, but this difference of judgement within these 2 tests groups is rather conspicuous although we have no explanation for it.

Table 3. Comparison of preferences for uncooked rice by test groups A and B

		Group A mean	Goup B mean	F ratio	F prob.
RAW369	TBS (P)	6.32	6.03	1.717	.1909
RAW397	Basmati	6.33	6.87	5.2777	.0222
RAW442	TBN (P)	6.26	6.21	.0670	.7960
RAW457	U.Bens (P)	6.27	6.18	.1771	.6742
RAW538	TBC	6.23	6.78	6.0134	.0147
RAW877	Ariete	5.17	5.73	5.2368	.0227

These results however lead us to conclude that evidence of an experimental bias is quite low.

Rice preference, cooked and uncooked

Preferences are measured by respondents on 1 to 10 points scales. Table 4 is built from variance analysis on mean scores obtained on each type of rice related to country . The Spanish data was available and therefore has been incorporated in the table.

Table 4 : Global preference by country, cooked and raw rice

Variable name	type	Mean of cooked and raw evaluation from 1 to 10 scale					F statistics	
		France n = 85	Greece n = 80	Netherl N = 80	Spain n = 91	Total n=336	F ratio	Fproba
PREF020	Basmati	7.24	7.40	6.16	5.21	6.47	18.78	.0000
PREF035	U.Bens (P)	4.89	7.90	6.06	4.02	5.67	55.90	.0000
PREF350	TBS17'(P)	5.83	7.47	6.39	6.55	6.55	7.79	.0000
PREF586	TBN10'(P)	5.28	6.91	5.92	3.77	5.43	30.24	.0000
PREF785	TBC15'	4.73	6.20	5.07	4.98	5.23	5.93	.0006
PREF801	Ariete	3.78	5.80	4.69	5.51	4.95	15.40	.0000
		n = 155	n = 80	n = 160		n = 395		
RAW369	TBS (P)	6.17	7.05	5.78		6.20	9.52	.0001
RAW397	Basmati	6.63	6.34	6.60		6.56	.52	.5919
RAW442	TBN (P)	6.05	7.34	5.86		6.24	15.25	.0000
RAW457	U.Bens (P)	6.21	6.73	6.03		6.25	3.34	.0365
RAW538	TBC	5.85	6.61	6.91		6.44	9.67	.0001
RAW877	Ariete	4.58	5.44	6.04		5.34	17.24	.0000

P = Parboiled

We look successively into country preferences for cooked (a) and uncooked (b) rices :

(a) cooked rices

In the average, the cooked rices that are best rated after sensory evaluation are the Taibonet Standard 17mn cooking time and the Basmati . It should be noted that apart from France, the 350 (Taibonet Standard 17') is rated higher than the 020 Basmati variety . This is particularly salient on the Spanish sample. 350 Taïbonet Standard 17' rates also higher than 035 Uncle Bens, another international reference in rice.

The lowest grades are obtained by the 801 Ariete sample in all countries except in Spain, where the 586 (Taïbonet normal 10mn cooking time) is rated even lower. Spaniards seem to reject more frequently than others those rices with smooth, firm textures.

It is apparent that the range and the order of preference vary significantly according to the country of origin.

Table 4 show that the F statistic is significant, indicating that preference structures are different in each country.

(b) uncooked rices

Raw rice scores seem to show less variation between samples. The French and Greek samples seem to value parboiled rices better than white rices, whereas Dutch respondents give better scores to white, non parboiled rices. The national differences seem however not significant on the Basmati and Uncle Bens evaluation.

Relationships between preferences for cooked and uncooked rices

In order to explain preferences for one particular types of rices, it may be useful to look at the other rices with which these preference are associated. Using a correlation analysis shown on table 5, we may look for patterns of preference for cooked rices (a) and uncooked rices (b). We may also control focus group results suggesting that preferences for uncooked and cooked rice might be associated (c)

(a) cooked rices

If we look at correlations between cooked rices preferences (table 5a), we find that preference for basmati (pref020) is not related to any other preference, with the exception of and 586 (Taibonet Normal 10' cooking time). We find a significant correlation inside the group of parboiled rices (035, 305, 586). The white rices 801 and 785 are also associated together, but the preference for these rices is hardly associated with the other white rice, the 020 Basmati. We also find a positive correlation between the 305 (parboiled Taïbonnet 17' cooking time) and the white 785 and 801 rices.

We may interpret these results in the light of the preference maps obtained in the Tex Save Riz program. 020 (Basmati) lies alone in the map area associated with tastes and savour descriptors. 801 (Ariete) and 785 (TBCamargue) lie together in an area described as starchy, sticky, swollen, aggregated, along with parboiled 305 (Taibonet 17mn). 035 Uncle Bens and 586 Taibonet are in the upper part of the map described as smooth, firm, elastic. Obviously, there are different preference patterns organised around colour, texture and flavour.

(b) uncooked rices

If we look at associations between uncooked rice preferences (table 5c), we find that colour seems to be the associating factor : preference for white and parboiled rice are clearly in separate groups. Thus, the visual preference for 020 basmati rice is predictive of the preference for 785 and 801 white rices, but not of the parboiled rices.

(c)

Focus group results suggested that preference for uncooked rices might be predictive of preference for cooked rice.

Looking at table 5b, there is evidence that preference for uncooked parboiled rices is predictive of preference for cooked parboiled rice. However, there is no noticeably strong relation between the uncooked and cooked state for one particular parboiled rice. The same comments could be made for white rices, with the exception of basmati rice : in this latter case, the preference for the raw basmati is predictive only of the preference for cooked basmati rice. It should be mentioned however that preference for uncooked 538 (Taibonet) is associated with cooked basmati preference, whereas 788 ariete is not. This is probably because the shape of the grain is also a factor combined with colour. Thus, rounder shape of Ariete makes it quite distinct from other white, longer rices, whereas the thin and long shape of Basmati is detectable at uncooked level by most respondents.

Table 5 : Correlation Coefficients, preference cooked/raw rices

	PREF020	p PREF035	p PREF305	p PREF586	PREF785	PREF801
PREF020	1.0000	*table 5a : France, Greece, Netherlands, Spain = 335*				
	P= .					
PREF035 P	.2726	1.0000				
	P= .000	P= .				
PREF305 P	-.0087	.2684	1.0000			
	P= .876	P= .000	P= .			
PREF586 P	.1752	.5489	.1295	1.0000		
	P= .001	P= .000	P= .019	P= .		
PREF785	.1294	.1440	.1521	-.0234	1.0000	
	P= .018	P= .009	P= .006	P= .672	P= .	
PREF801	-.0309	.1010	.3797	-.0587	.3364	1.0000
	P= .577	P= .069	P= .000	P= .290	P= .000	P= .

Table 5b France, Greece, Netherlands n = 236

	PREF020	PREF035	PREF305	PREF586	PREF785	PREF801
RAW369 p	.1756	.3765	.2467	.2561	.0425	.1740
	P= .007	P= .000	P= .000	P= .000	P= .515	P= .008
RAW397	.2812	.1005	.0440	.0029	.0884	.0531
	P= .000	P= .125	P= .502	P= .965	P= .177	P= .419
RAW442 P	.1471	.4814	.2535	.3363	.0411	.1938
	P= .024	P= .000	P= .000	P= .000	P= .531	P= .003
RAW457 P	.1426	.3636	.1947	.2287	.0337	.1069
	P= .030	P= .000	P= .003	P= .000	P= .609	P= .104
RAW538	.2050	.0613	.1727	.0485	.2028	.1806
	P= .002	P= .350	P= .008	P= .458	P= .002	P= .006
RAW877	.0531	.0287	.1549	-.0018	.3902	.2126
	P= .415	P= .660	P= .017	P= .978	P= .000	P= .001

	P RAW369	RAW397	P RAW442	P RAW457	RAW538	RAW877
RAW369 P	1.0000	*Table 5c: France, Greece, Netherlands n = 390*				
	P= .					
RAW397	-.1151	1.0000				
	P= .025	P= .				
RAW442 P	.7657	-.0702	1.0000			
	P= .000	P= .173	P= .			
RAW457 P	.7440	-.0638	.6993	1.0000		
	P= .000	P= .216	P= .000	P= .		
RAW538	-.1370	.6306	-.0859	-.1561	1.0000	
	P= .008	P= .000	P= .095	P= .002	P= .	
RAW877	-.1603	.3180	-.1596	-.1369	.4669	1.0000
	P= .002	P= .000	P= .002	P= .007	P= .000	P= .

(Coefficient / (Cases) / 2-tailed Significance)
P = Parboiled

Patterns of preferences may be further evidenced if we associate scores of preference of cooked uncooked rices in a factor analysis. The result of the rotated factor matrix (fig.6) shows that four factors seem to explain the variance contained in the data set : factor 1 is described by the colour of parboiled, uncooked rices, factor 2 groups those rices with soft, pasty structure, factor 3 is a basmati axis, associating the other uncooked white rices, and factor 3 groups those parboiled rices with a firm texture.

Table 6 Factor analysis of preference scores cooked/uncooked rices

	Factor 1	Factor 2	Factor 3	Factor 4
PREF020 (basmati)	.35417	-.11590	**.62280**	.01921
PREF035 (U.Bens, P)	.32613	.19652	.08103	**.77569**
PREF305 (TB 17', P)	.13569	**.67088**	-.03115	.42558
PREF586 (TB 10', P)	.14688	-.07281	.07792	**.84911**
PREF785 (TBc 15')	.05899	**.78546**	.17006	-.18899
PREF801 (Ariete)	.11725	**.79602**	-.01416	.12620
RAW369 (TB 17', P)	**.89065**	.08098	-.01169	.14175
RAW397 (basmati)	-.11685	.02297	**.83100**	.06164
RAW442 (TB 10', P)	**.83190**	.08321	-.07445	.29001
RAW457 (U.Bens, P	**.87511**	.05549	-.08535	.12101
RAW538 (TBc 15')	-.19301	.24998	**.77456**	.09711
RAW877 (Ariete)	-.24871	.48950	.47101	-.05855

These results confirm therefore the existence of a pattern of preferences discriminating among white and parboiled rices, on the one hand, soft and firm rices, on an other hand. Basmati rice is distinctive from all other rices, and is related to other white rices only at uncooked stage. However, we may also conclude that, apart from the particular case of basmati rice, respondents are not able to recognize their preferred uncooked rice once it is cooked : correlation scores between uncooked and cooked stage for one particular white or yellow rice are not higher than the relations between one uncooked rice and the group of rices , white or yellow.

Images and attributes associated to the rices

In questionnaire A, we had two measures of the attributes associated to the rices. One question measured on a 10 points scale the adequation of the rices either with an ordinary type of eating situation, or with a special occasion (a). The other (b) measure was a group of 9 semantic, 7 points scales with opposite ends (ex. modern-not modern, exotic-not exotic...see table 7 below)

(a) adequation of rices to eating situations :

We have shown on figure 2 those rices for which the judgements seem to differ according to country. It can be noted that the analysis of variance of the score obtained by each rice in a « ordinary meal situation » and a « special occasion » by country reveals that the F probability test is significant only in a few cases. In ordinary situations, there is a significant difference between the Greek scores and the French and Dutch scores : the Greek tend to consider that 785 and 801 rices are adapted for ordinary situations, whereas the French and the Dutch consider these rices as not adequate.
For special occasions, the Greek favour 035, 305 and 586 rices (all parboiled rices) whereas 035 is rejected by the Dutch and 586 by the French, both rejecting 305.

Figure 2 indicates quite clearly an opposition between the Greek sample, on the one hand, and the Dutch and French sample on the other hand, in terms of rice adequation to ordinary or special meals.

Fig. 2 Rice adequation to ordinary vs special types of meals, comparison of 3 countries

| | France | | Greece | | Netherlands | |
	Rices Adequate	Rices not adequate	Rices Adequate	Rices not adequate	Rices Adequate	Rices not adequate
Ordinary situations	020basm 035ubens 305TB17' 586TB10'	801ariete	020basm 035ubens 305TB17' 586TB10' 785TBCam 801ariete		020basm 035ubens 305TB17' 586TB10'	785TBCam 801ariete
Special occasions	020basm	035ubens 586TB10' 785TBCam 801ariete	020basm 035ubens 305TB17' 586TB10'	785TBCam 801ariete	020basm	785TBCam 801ariete

(b) semantic scales :

These scales are supposed to explain consumer preferences for the different rices, as they relate to images and attributes about rice that are commonly used by these consumers to differentiate among food products. We try to find whether these attributes discriminate among the different rices by looking at the range and variances of the mean score of the rices on each semantic scale (table 7).

Table 7 : Analysis of the mean scores of six rices on a 7 points semantic scale

Semantic scales	mean	min.	max.	range	variance
Dietetic - not dietetic	3.366	3.018	3.951	.933	.175
Very digestible -not very dig.	3.302	2.898	3.609	.711	.070
Difficult to cook - easy	4.670	4.455	4.856	.401	.021
Nourishing- not nourishing	3.186	2.987	3.460	.474	.041
Not exotic - Exotic	3.252	2.528	4.769	2.24	.679
Modern - Old type	4.348	2.677	5.444	2.767	.991
Sophisticated - not soph.	4.586	2.754	5.713	2.959	1.115
Special -Common	4.525	3.099	5.649	2.550	.819
Natural-artificial	3.300	2.964	3.735	.771	.061

If we look at the range and the variances of the scores, it appears that only a few descriptors seem to differentiate the rices : Exotic, Modern, Sophisticated, Ordinary. On the contrary, scores are quite equivalent on the following factors : Nourishing, Easy to cook, Dietetic, Digestible, Natural are descriptors that are common to any rice. These two lists of descriptors suggest two things : First, all rices, parboiled or not, are equally considered as « natural », which is in contradiction with what people said in the focus groups, where they expressed that parboiled rices were « industrial ». Second, the descriptors that seem to best differentiate the rices are related to images related to a social context, (ex. : exotic), whereas descriptors of intrinsic attributes of the rices (ex. : digestible) are not discriminating.

In order to detect country differences in the use of the descriptors to differentiate the rices, we have run a one way Anova procedure (Kruskal-Wallis test) testing the scores obtained by each rice on the semantic scales in the three national groups. Figure 3 indicates those rices for which the chi-square test proves significant (under the .0001 value).

Fig. 3 : Rices for which the Kruscal-Wallis chi-square test proves significant at the .0001 level by country : France, Greece, Holland

Items of the 7 points semantic scale :	
Dietetic	586, 785, 801
Digestible	801
Easy to cook	020
Nourishing	020, 785, 801
Exotic	020, 035, 305, 586, 785, 801
Modern	020, 035, 305, 586, 785, 801
Ordinary	020, 035, 305, 586, 785, 801
Sophisticated	020, 035, 305, 586, 785, 801
Natural	035, 305, 586, 785, 801

Figure 3 suggest again that the rices are evaluated differently by country mostly on semantics that are related to images rather than on those that are related to intrinsic attributes of the rice. To some extent, we may conclude that, for our 3 national samples, each of 6 rices proposed are equally dietetic, digestible, easy to cook. A restriction should be made for the rices that belong to the soft, starchy group, such as 785TBC and 801Ariete that may be preferred because they are thought to be more nourishing, digestible and dietetic. It may be also noted that the attribute « natural » is not equally used for the rices except for the 020basmati rice

This analysis of country differences should be confirmed by further research using the complete European data set including Spain and UK.

Conclusions

Our purpose was to point out those factors that would best explain hedonic preference of 6 different rices by consumers chosen in 5 countries. Data availability has allowed us to consider only consumers from France, Greece and Holland. Spanish data on global preference of cooked rice has also been analysed.

The experimental design might have been a source of bias. It seems however that the judgements on uncooked rices are not influenced by the different experimental conditions in which the consumers were submitted.

Our findings show that personal characteristics of the respondents (sex, age, income, size of household, frequency of cooking) had no detectable influence on global preference. It was found that the older group of age (over 60) had a systematic tendency to give higher grades, which led us to eliminate this class age from several analysis.

On the contrary, country of origin seem to be a major discriminant factor of preference, both for cooked and uncooked rices. Yellowish, parboiled rices seem more appreciated by the French and the Greeks, whereas the Dutch prefer plain white rices. These findings suggest that the cultural factor is still important in rice preference.

It is not confirmed that parboiled rices are perceived as more « industrial » or less natural than white rices.

The colour of the rice seems to be a good predictor for cooked rice preference, although the respondents are unable to relate specifically their preference for a particular uncooked rice with the same cooked rice. This lack of relation justifies branding policies by the manufacturers in order to help consumer when they choose a rice on the basis of its aspect.

Preference data analysis (correlation and factorial analysis) suggests that there are 4 patterns of preference for rice : a first pattern based on colour preference, an other one based on soft overcooked texture, an other one based on firm texture, and a basmati pattern that may be interpreted as a flavour pattern.

Looking at specific rices, it is interesting to note that European rices may be better evaluated than international « standard rices » such as Basmati or Uncle Bens : This is the case with the Taïbonet Special 17' cooking time, superior to Basmati in Greece, Holland and Spain, and superior to Uncle Bens in the same

countries. To a lesser extent, this is also the case with the Taîbonet Normal 10' cooking time that obtains a better score than Uncle Bens rice in France and an almost equivalent one in Holland

The semantic scales used by the consumers to explain their preference seem to be discriminant only when they relate to social images. Intrinsic attributes such as health or ease of cooking seem to be equivalent for all types of rices. This is probably on this type of « image » descriptors that rice brands can most easily position their products.

The limitations to these results are quite obvious. We need to analyse the complete set of data in order to confirm cultural differences. Also, we have favoured so far bi-varied analysis : we will have to use multivariate analysis in order to relate preference of each rice with different sets of variable, and obtain a more complete picture of consumer evaluation of rice quality in Europe.

A further development of the analysis of this European consumer data consists in an association with the descriptors obtained through sensory analysis and with laboratory instruments.

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