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QUALIFICATION OF ASSESSORS IN FOOD PROFILE ANALYSIS AND OTHER NEW DEVELOPMENTS OF PROFISENS

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Abstract

Sensory analysis is a fundamental tool in food quality assurance [6]. Beside consumer tests (that focus on the acceptance of products), trained panels provide much detailed sensory data on the intensity of the most relevant attributes. The analysis of descriptive sensory data is a very complex task of this science. One of the key issues is the reliability of the panel members in making decisions. The research group of BME and BCU has created a specialized software — ProfiSens — for food profile analysis. ProfiSens was applied in research and education, in designing and carrying out profile analyses by different panelists in hundreds of cases. Several times not only the food samples, but also the group of panelists were to be qualified. In our paper we discuss a new method based on geometrical properties of the profile polygon, which offers a fast way for the qualification of the assessors.

We also often met the problem of willing to use earlier defined profile analysis scoresheets or even only some of their attributes. The solution for these problems is to create a DataBase, containing all the data of designed scoresheets, and to make possible searching and picking up any wanted attributes from the DB. We discuss our results in this field as well.

Keywords: Food Sensory Testing, Profile Analysis, Qualification of Assessors, DataBase of Attributes.

1. Introduction

Sensory quality is an important part of product potential, especially in food industry. Since sensory quality is perceived by human assessors, the subjective character cannot be totally eliminated, that is why designing and implementing sensory tests can be effectively aided by the application of Mathematical Statistics. By the evaluation of the tests we cannot avoid applying the modern IT (Information Technology) tools.

Profile analysis is one of the often applied laboratory tests, in which trained assessors and/or experts (preferably a product specific panel) take part. The reliability of this method is based on the reliability of the assessors, so that it is useful to qualify them in each profile analysis test.

The Sensory Laboratory of BCU has a specially designed sensory booth system which was established in accordance with the relevant ISO standards [1]. The researchers of the Postharvest Dept., Sensory Laboratory (BCU) and of the Dept. of General and Analytical Chemistry, Chemical Information Technology Group (BME) created a profile analysis supporting software: ProfiSens. The language of the software is Visual Basic for Excel (VBA); its main functions are the following: It creates kitchen lists for sample preparation and scoresheets for the assessors, collects data (electronically) from the completed scoresheets, performs statistical evaluation, and creates diagrams of the results [3, 4, 5].

ProfiSens was applied in designing and carrying out profile analyses in hundreds of cases. The discussion of these applications resulted in two new developments, which are closely linked to the former versions of the ProfiSens software. The first development offers a fast graphic way to investigate the reliability of panelists, the second one is a DataBase containing the attributes of the former profile analyses, ordered by product types.

2. Qualification of Assessors

To understand the problem of investigating the reliability of panelists, we discuss two profile analysis tests. The first one is a Trappist cheese test, which was part of our ProfiSens software demonstration on the 2004 October IzFeszt Food Exhibition (BCU).

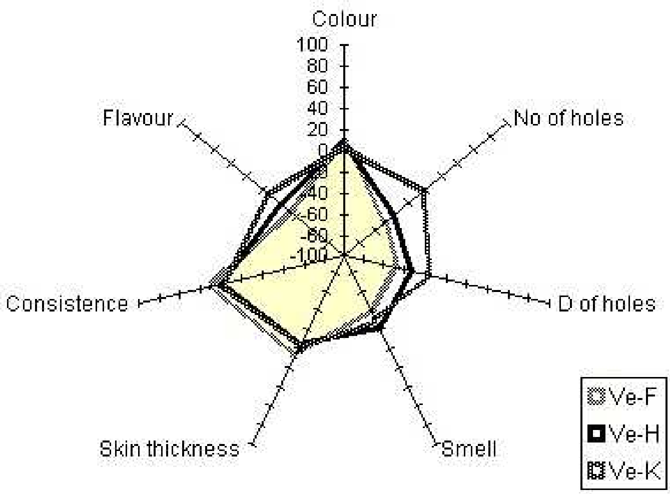

Fig. 1. Profile of differently stored Trappist cheeses of the first factory

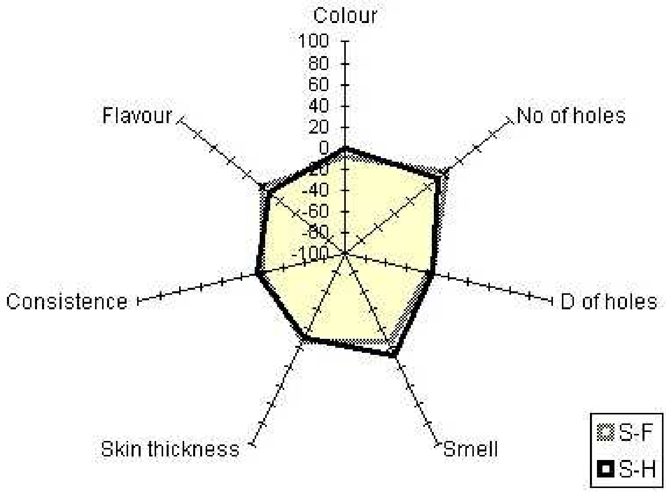

Fig. 2. Profile of differently stored Trappist cheeses of the second factory

The goal of this demonstration was to show the features of ProfiSens to food producers and to let them use it in a quite general food profile analysis. In this test series we investigated the effect of deep freezing to Trappist cheeses, e.g. the question was whether the way of storing or the difference between cheese producers has stronger effect on the cheese profile.

As to be seen on the profile polygons (*Fig. 1–2*), the effect of different factories proved to be stronger. In *Fig. 3* and in *Table 1* we show a special attribute: the flavour of the cheeses.

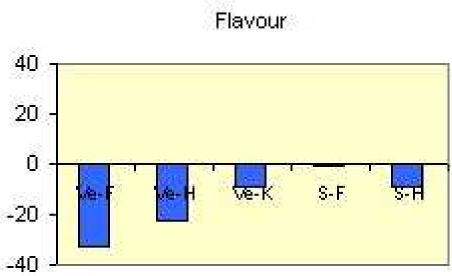

Fig. 3. Flavour of Trappist cheeses

Assessors taking part in the cheese test were somehow food experts, but they were not cheese specialists. Since the profile analysis was carried out on an exhibition, for the demonstration of the software, there was no possibility to make a special training for the panelists (so the reliability of the results is also limited).

Table 1. ANOVA of Trappist cheeses

Summary of Single Factor ANOVA					
Groups	Count	Sum	Average	Variance	
Ve-F	13	−422	−32	1371	
Ve-H	13	−286	−22	491	
Ve-K	13	−110	− 8	620	
S-F	13	− 8	− 1	582	
S-H	13	−110	− 8	1463	
S. of Var.	SS	df	MS	F	P-val
Between Gr.	8379	4	2095	2.3135	0.0678
Within Gr.	54327	60	905		
				F crit	
Total	62706	64		2.5252	
Flavour	sd (5%) = 23.6		sd (1%) = 31.4		
	Ve-F	Ve-H	Ve-K	S-F	S-H
V-F	–	no	5%	1%	5%
Ve-H	10.5	–	no	no	no
Ve-K	24.0	13.5	–	no	no
S-F	31.8	21.4	7.8	–	no
S-H	24.0	13.5	0.0	7.8	–

The second profile analysis example, shown here in *Figs. 4, 5, 6* and in *Table 2*, belongs to a six months long apple storing experiment. The panelists in this experiment have either got a special training, or been apple experts.

It is obvious from the profile polygons of the apples, that the influence of treatment on the attributes of the apples was not considerable till January.

Considering the ANOVA tables of the selected single attributes – flavour of the cheeses and flesh colour of the apples – the ratio of given significant differences to the absolute value of the samples' average shows a warning:

in the cheese–test this ratio is close to or bigger than 1, in the case of apples it is close to or smaller than 0,5. These ratios as well as the F values or variances mean a considerable difference between the reliability of the two panels.

Getting an overview on the reliability of a panel, it would be very tiresome to investigate the whole ANOVA tables for each attribute step by step. Our research team designed a new and fast graphic reliability test. The theoretical background of this qualification is the fractal theory, which characterizes fractals by their area/perimeter ratio. Of course this ratio is not enough to describe a profile analysis polygon, because a rotation by a $k * 2\pi/n (0 < k < n)$ angle of a profile polygon

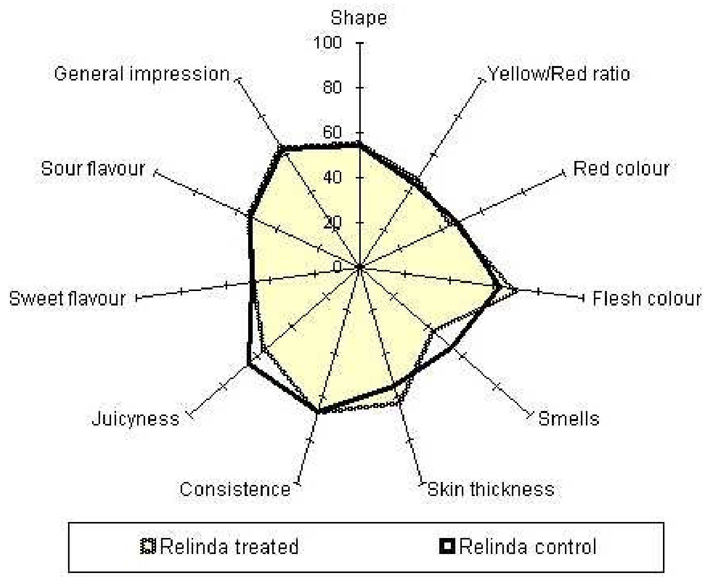

Fig. 4. Profile of Relinda apples treated by SmartFresh (2005 January results)

means exactly a shift of the assessment by *k* attributes. The exact characterization is offered by the area/perimeter ratio *and* the gravity centre of the polygon. In *Fig. 7* we show the gravity centre (GC) of the first cheese sample's polygon.

The coordinates of the gravity centre shown on *Fig. 7* were calculated for each sample and for each assessor by our own extension of the ProfiSens software. This extended module adds as many new worksheets to the basic Excel workbook — that contains the numerical and graphical results of a food profile analysis, carried out with the support of ProfiSens — as the number of samples. The new Excel worksheets contain the Cartesian coordinates of the profile polygon's gravity centre, and as third Cartesian coordinate the evaluated area/perimeter ratio of the polygon belonging to each individual panelist.

In *Figs. 8* and *9* the 3D points of a cheese and of an apple profile analysis' panelist group are shown. The gravity centres are elements of the XY plane, the third coordinate is the area/perimeter ratio (its axis denoted by T/K). Using the same coordinate units, it can be easily seen that the panel of the (Relinda treated) apple profile analysis is a good one, while the panel of the (Ve–F) cheese profile analysis is not reliable. Of course the results of this new test can be also numerically described, for example by Hotelling test used in qualification of air–raids with respect to geographical precision and explosion efficiency.

Figs. 10 and *11* show only the gravity centres. For the cheese profile analysis (*Fig. 10*), gravity centres are labelled by the values of the area/perimeter ratio,

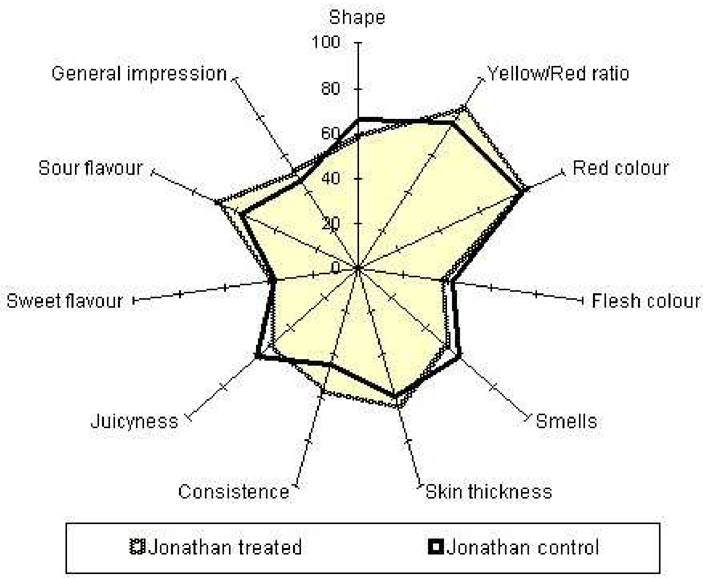

Fig. 5. Profile of Jonathan apples treated by SmartFresh (2005 January results)

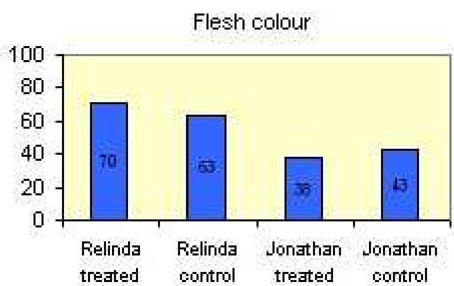

Fig. 6. Flesh colour of different apples

similarly as in the *Fig. 8* by the assessors' codes (*bx*).

Figs. 8–11 were created by the Statistica 6.1 software, linked as an OLE object under the direction of VBA — that means that for the graphical extension of ProfiSens by the module for qualification of assessors a StatSoft Statistica license is necessary.

Table 2. ANOVA of different apples

Summary of Single Factor ANOVA					
Groups	Count	Sum	Average	Variance	
Relinda treated	12	842	70	399	
Relinda control	12	756	63	349	
Jonathan treated	12	451	38	326	
Jonathan control	12	510	43	489	
S. of Var.	SS	df	MS	F	P-val
Between Gr.	8907	3	2969	7.59507	3E-04
Within Fr.	17200	44	391		
				F crit	
Total	26106	47		2.81646	
Flesh colour	sd (5%) = 16.3		sd (1%) = 21.7		
	Re. treat.	Re. cont.	Jo. treat.	Jo. cont.	
Relinda treated	–	no	1%	1%	
Relinda control	7.2	–	1%	5%	
Jonathan treated	32.6	25.4	–	no	
Jonathan control	27.7	20.5	4.9	–	

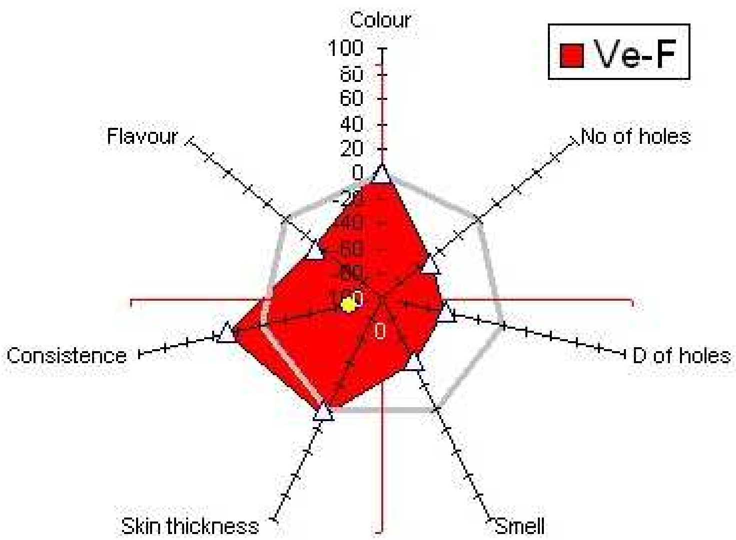

Fig. 7. Gravity centre of a cheese profile polygon

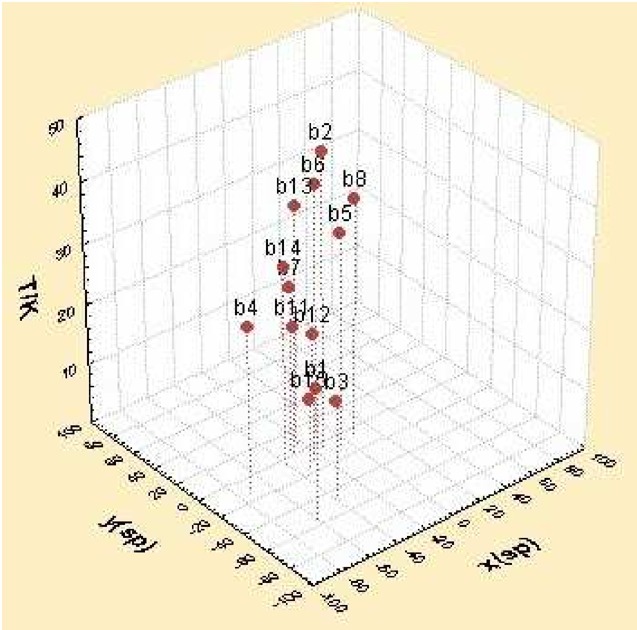

Fig. 8. Area/perimeter over gravity points (cheese)

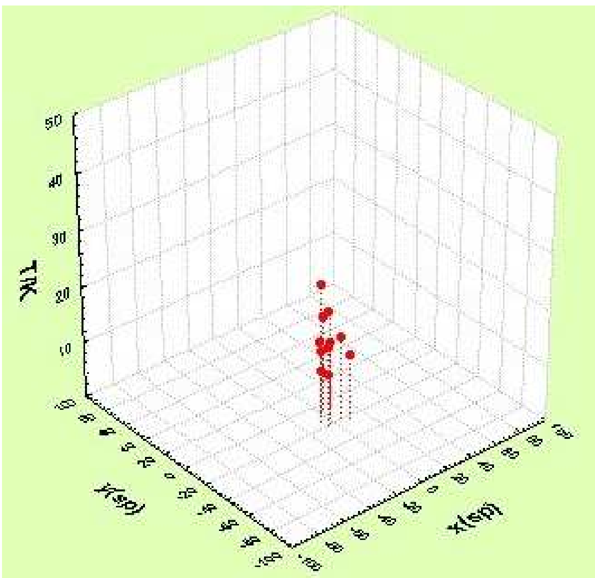

Fig. 9. Area/perimeter over gravity points (apple)

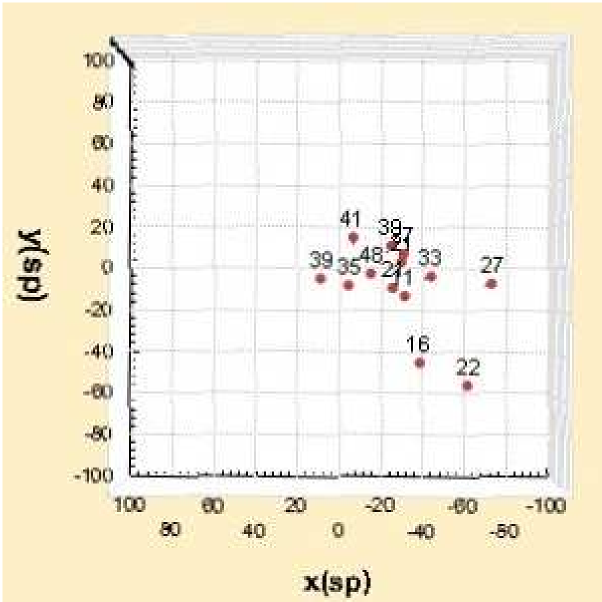

Fig. 10. Gravity points (cheese)

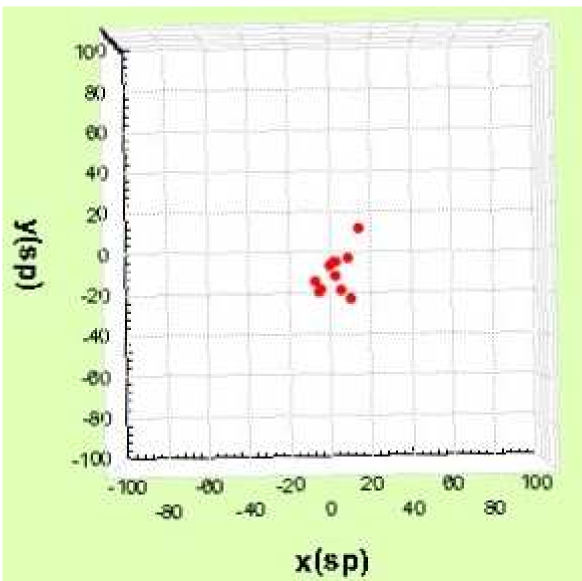

Fig. 11. Gravity points (apple)

Table 3. Qualification of different panels

	#S	#A	Prof. Anal.	E	G	M	W
Cheese	5	32	ÍzFeszt		1		4
# At = 8	3	18	2005 Oct 1			2	1
	3	9	Alpener-1		1	2	
# At = 5	3	12	Alpener-2			3	
# At = 9	3	20	Goat			3	
G. Peas	6	7	Wolf-1	3	2	1	
	6	7	Reno-1		6		
# At = 9	6	7	Kerstin-2	2	4		
	6	7	Skinado-2	6			
	4	7	Kerstin-3	4			
	4	7	Reno-3	1	3		
	4	7	Skinado-3	2	2		
	5	7	Wolf-3	4			
Apple	4	12	2004 Oct (1)		3	1	
	4	12	2005 Jan (1)		4		
# At = 12	4	14	2004 Oct (2)		2	2	
	4	12	2005 Jan (2)		2	2	
Wine	6	10	White 1-A1	4	2		
	4	10	White 1-A2	2	2		
# At = 13	6	10	Rose 2-A	6			
	6	10	Cork 2-B	2	4		
	6	10	Red 3-A	5	1		
	6	10	Cork 3-B	6			
	6	10	Glass 4-A	6			
	6	10	White 4-B	6			
	6	10	White-E	1	5		
	6	6	Rose-E	6			
	6	6	Red-E	6			

#S = No. of Samples
#A = No. of Assessors
#At = No. of Attributes
where E: Excellent = dmax ≤ 15 and relmax ≤ 0.25
G: Good = dmax ≤ 30 and relmax ≤ 0.5
and dmax = max [distance (GC, GC (Ave))]
M: Medium = dmax > 30 and relmax > 0.5
and relmax = distance [(A/P)/(A/P(Ave));1]
W: Weak = dmax > 30 and relmax > 0.5

The other new development of ProfiSens – the DB of food attributes, discussed in the next part of our paper – made possible to design profile analysis experiment series where the assessors belong to product specific panels. In *Table 3* we summarized the qualifications of product-specific assessors, as well as the cheese and apple panels discussed so far.

Qualification summaries clearly show the difference between the product-specific wine panel and the weakest one, the freely chosen cheese panel on the Izfeszt Exhibition.

3. The Food–Attributes DataBase of ProfiSens

In the academic year 2004/2005 we have used the ProfiSens software in more than hundred food profile analyses each of them covering several attributes. When the goal of the tests was to investigate the influence of treatments, storing circumstances etc. on the profiles, we made test series using the same attributes in each occasion.

In projects investigating different apple, green pea, tomato, wine etc. samples, we often used almost the same attributes, varying only one or two of them. For these slightly different scoresheet series to be easily created, we built a DataBase of the already applied food attributes, and extended the ProfiSens software by a new module: the PSCommander that controls and manages the data. The main functions of PSCommander are very similar to the well–known Norton Commander software, where its name comes from.

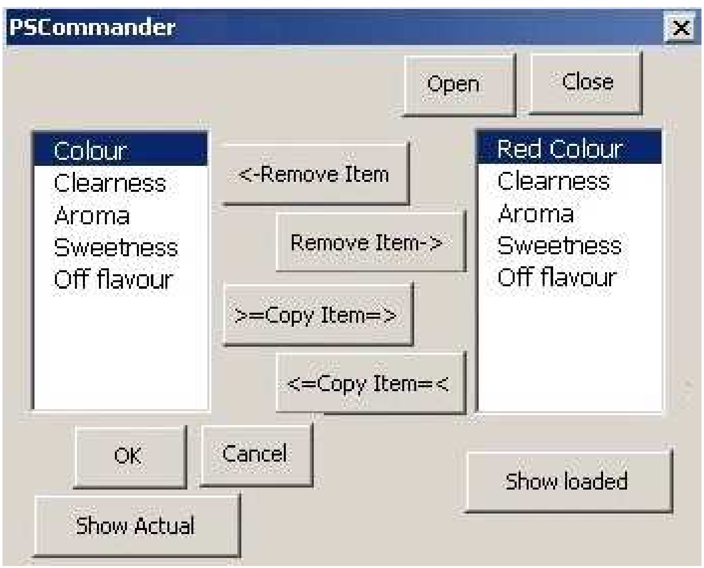

Fig. 12. Some function buttons and the two windows of the PSCommander

Fig. 12 shows some steps of PSCommander in use. In the right window there is the source file containing the attributes of a red wine profile analysis, on the left the target file's attributes made for a white wine test. The only difference in attributes is colour. PSCommander makes it possible to copy all the red wine attributes, and thereafter change the description of the single different attribute (colour).

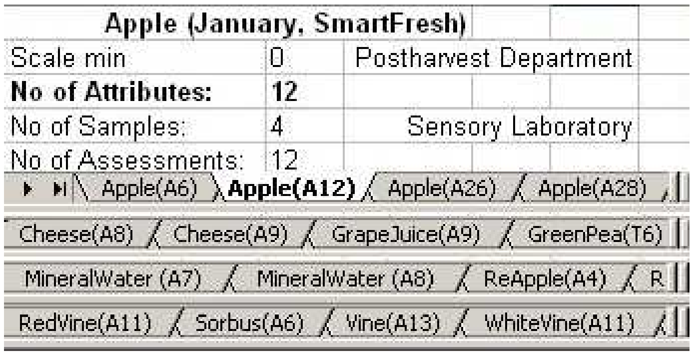

Fig. 13. 188 attributes of 15 Profile tetst!

A part of the Excel-based attribute DB, containing 188 food attributes ordered in 15 Excel worksheets of the 15 different profile tests, is shown in *Fig. 13*. The active worksheet belongs to an apple profile test, where it is obvious that the ordering corresponds to the structure of a basic ProfiSens test sheet. The MS Excel worksheets of the DB can be easily linked to an MS Access file, each as a table.

4. Discussion

The experiences in developing, execution and processing more than 1500 assessments and now hundreds of testing occasions verified that the ProfiSens sensory analysis supporting software can be successfully used in research, education and industrial testing. To reduce the time demand of the preparation and extend the evaluation steps, we created a new module — PSCommander —, and a linked new software for the qualification of the assessors. The new parts and the developed new test method improved the efficiency of research concerning the market potential of new fruit or vegetable varieties [2], new formulas or different treatments in food industry.

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List of Symbols and Abbreviations

A/P	Area/Perimeter ratio
Ave.	Average
BCU	Budapest Corvinus University
BME	Budapest University of Technology and Economics
Cont.	Control
D	diameter
DB	database
GC	Gravity Centre
Gr.	Group
IT	Information Technology
LAN	Local Area Network
sd	Significant difference
treat.	treatment
S. of Var.	Source of Variation
VBA	Visual Basic for Applications
#A	Number of Assessors
#At	Number of Attributes
#S	Number of Samples

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