## RTB Breeding



Activity $\mathrm{n}^{\circ} 3$ : Evaluation of acceptability thresholds of key quality traits for the different RTB food products

Online module $\mathrm{n}^{\circ} 2$ : Sensory attributes and sampling

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## 1 - Choice of samples


$\rightarrow$ 1: Reminders: Do not forget!
$\rightarrow$ 2: Number of samples
$\rightarrow$ 3: Contrasting samples for different sensory attributes
$\rightarrow$ 4: Sample coding
$\rightarrow$ 5: Experimental design of the consumer test
$\rightarrow$ 6: Order of presentation of samples to the consumer

- 1: Reminders: Do not forget
- The same raw materials must be use for all analyses (hedonic and descriptive tests and instrumental analysis) $\rightarrow$ all analyses must be performed at the same time
- Calculate the quantity required (in one batch) for all analyses
- Each product tested by each consumer should be provided from the same batch of production (for statistical analysis)


## 1 - Choice of samples

- 2: Number of samples: A minimum of 6 samples

Ideal curves (fictitious) :

JAR


Firmness

RDA

JAR Sweetness


SH

## 1 - Choice of samples

Firmness : With the 6 ideal samples


4 samples
+2 others


Closer to reality : with 6 random samples


With three additional samples, the bell-shaped curve is found again.

That's why, more than 6 samples is better.

With the 6 samples (figure 1 ) +2 others (figure 2 ) +1 new

- 3: Contrasting samples for different sensory attributes

It's very important to have contrasting samples for all selected sensory attributes studied.

Example: 9 samples and 5 sensory attributes

- Firmness
- Bitterness
- Stickiness
- Sweetness
- Mealiness



## 1 - Choice of samples

Examples of possible curves, always with the same 9 samples


## 1 - Choice of samples



There are two contrasting groups of samples
Add additional samples to confirm a possible
curve for sweetness


There are two contrasting groups of samples and two samples alone for mealiness

## 1 - Choice of samples



QDA
3
The 9 samples are contrasted but there are no correlations between intensity of stickiness and consumer appreciation

Redefine the sensory attribute

Even if you have chosen a sufficient number of samples for the study (9), it is not always possible to obtain acceptability thresholds for all the sensory attributes chosen.

To select the samples to be analysed, you can refer to previously acquired results (RTB Food for example) which have identified contrasting varieties, to ensure that you have a sufficient number of contrasting samples for each sensory attribute.

## 1 - Choice of samples

- 4 : Sample coding

Samples must be named by a random three-letter code in the study

Example :

| Samples | Name of samples for the study |
| :---: | :---: |
| 1 | SFU |
| 2 | ZKT |
| 3 | DVI |
| 4 | APG |
| 5 | NDX |
| 6 | OTB |

## 1 - Choice of samples

- 5: Experimental design of the consumer test



## 1 - Choice of samples

- Experimental design : 6 samples available on the same day
- Number of samples for which the experimental design is the simplest
- 100 to 125 consumers in total
- All consumers will test all products (but in different orders)
- It is possible to carry out the consumer test in one day and to perform the QDA and instrumental analyses at the same time or in the days that follow.

!Although this is the easiest way to set up, it is not the most optimal, because 6 samples is not always enough to calculate the acceptability thresholds

- Experimental design : Less than 6 samples available on the same day

If you have fewer than 6 products available at the same time (on the same day):

(2)you will have to run the series of analyses (consumer tests + QDA + instrumental analyses) several times until you reach a minimum of 6 samples in total

## 1 - Choice of samples

- Experimental design : Less than 6 samples available on the same day


## Example : 8 samples (different varieties) available at two different times



## 1 - Choice of samples

- Experimental design : Less than 6 samples available on the same day

All the analyses must be repeated until results are available for at least 6 different varieties. ( it is possible to study more than 6 varieties in this way )

The analyses can be carried out in two, three or four stages... The only constraint will be the time it takes to carry them out

As there are fewer than 6 samples to be analysed at a time, all consumers can taste all the products and there is no particular experimental design

## 1 - Choice of samples

- Experimental design : More than 6 samples available on the same day

As a consumer cannot taste more than 6 products at a time, not all consumers will be able to taste all the products.

However, each product must be tasted by at least 100 consumers.

In this situation, we need to put in place what is known in sensory evaluation as a balanced incomplete experience plan.

Incomplete: means that not all consumers tasted all the products
Balanced : means that each product is tasted by an identical number of consumers

## 1 - Choice of samples

- Experimental design : More than 6 samples available on the same day What is a balanced incomplete experience plan? Example with 5 samples:

What we know at the start:

- 5 samples in total (coded from 1 to 5 )
- each consumer tastes only 3 products.

For 5 samples, here are the different possible combinations of 3 samples:

$$
\text { 123 / } 124 \text { / } 125 / 134 / 135 / 145 / 234 / 235 / 245 / 345 \text { / } 135
$$

$\rightarrow$ For a total of 5 samples, $\mathbf{1 0}$ possible combinations

## 1 - Choice of samples

- Experimental design : More than 6 samples available on the same day

For a total of $\mathbf{5}$ samples, $\mathbf{1 0}$ possible combinations of three samples $\rightarrow$
There is a formula for calculating this number of combinations

Reminder: In mathematics, the factorial (noted "!") of a natural number $n$ is the product of the strictly positive integers less than or equal to $n$.

Example: factorial of $5=5!=5 * 4 * 3 * 2 * 1=120$

- 5 samples in total $=$ Number of samples $=\mathrm{Nb}$ S
- each consumer tastes only 3 products. = Number of samples per consumer = Nb SpC
Number of combinations $=\frac{\mathrm{Nb} \mathrm{S!}}{(\mathrm{Nb} \mathrm{S}-\mathrm{Nb} \mathrm{SpC})!}{ }^{* \mathrm{Nb} \mathrm{SpC}!}$
- Experimental design : More than 6 samples available on the same day

For a total of 5 samples, $\mathbf{1 0}$ possible combinations of three samples
There is a formula for calculating this number of combinations:

- 5 samples in total $=$ Number of samples $=\mathrm{Nb} S=5$
- each consumer tastes only $\mathbf{3}$ products. = Number of samples per consumer $=\mathrm{NbSpC}=3$

Number of combinations $=$ $\qquad$

Number of combinations $=\frac{5 * 4 * 3 * 2 * 1}{(5-3)!* 3!}=\frac{5 * 4 * 3 * 2 * 1}{2 * 1 * 3 * 2 * 1}=\frac{5 * 4}{2}=10$


## 1 - Choice of samples

- Experimental design : More than 6 samples available on the same day

For 5 samples, 10 combinations of 3 samples are possible. On these 10 combinations, each product appears 6 times: 123 / 124 / 125 / 134 / 135 / 145 / 234 / 235 / 245 / 345

To avoid telling and writing down all the possibilities, there is a formula:
Number of times samples appear $=\frac{(\mathrm{Nb} \mathrm{S}-1)!}{(\mathrm{Nb} \mathrm{S}-\mathrm{Nb} \mathrm{SpC})!^{*}(\mathrm{Nb} \mathrm{SpC} \mathrm{-1)!}}$

$$
\text { Number of times samples appear } \frac{(5-1)!}{(5-3)!*(3-1)!} \frac{4^{*} 3 * 2 * 1}{2 * 1 * 2 * 1}=\frac{3 * 4}{2}=6
$$

## 1 - Choice of samples

- Experimental design : More than 6 samples available on the same day
$\checkmark$ We know that with 5 samples, if each consumer tastes 3 , there are 10 possible combinations of three samples.
$\checkmark$ Of these 10 possible combinations, each sample is present 6 times.
$\checkmark$ So if we have 10 consumers, each sample will be tasted 6 times.
$\rightarrow$ How many consumers we need to question so that each sample is tasted at least 100 times ?

| Number of combinations = number of consumers | 10 | $166,7=167$ |
| :--- | :---: | :---: |
| Number of times samples appear | 6 | 100 |

Total number of consumers $=\frac{100 * \text { Number of combinations }}{\text { Number of times samples appear }}$

## 1 - Choice of samples

- Experimental design : More than 6 samples available on the same day

Summary of the steps to find out the total number of consumers to question:
-You decide : Number of samples + Number of samples per consumer
-Calculation of the number of combinations:

$$
\text { Number of combinations }=\frac{\mathrm{Nb} \mathrm{S!}}{(\mathrm{Nb} \mathrm{~S}-\mathrm{Nb} \mathrm{SpC})!^{*} \mathrm{Nb} \mathrm{SpC}!}
$$

-Calculation of the number of times each sample appears:
Number of times samples appear $\underset{(\mathrm{NbS}-\mathrm{Nb} \mathrm{SpC})!^{*}(\mathrm{Nb} \mathrm{SpC} \mathrm{-1})!}{(\mathrm{Nb} \mathrm{S} 1)!}$
-Calculation of the total number of consumers

$$
\text { Total number of consumers }=\frac{100 * \text { Number of combinations }}{\text { Number of times samples appear }}
$$

## 1 - Choice of samples

| Numbers of samples | Numbers of samples tasted by consumers | Numbers of combinations | Number of times samples appear | Total number of consumers |
| :---: | :---: | :---: | :---: | :---: |
| 7 | 4 | 35 | 20 | 175 |
| 7 | 5 | 21 | 15 | 140 |
| 7 | 6 | 7 | 6 | 117 |
| 8 | 4 | 70 | 35 | 200 |
| 8 | 5 | 56 | 35 | 160 |
| 8 | 6 | 28 | 21 | 134 |
| 9 | 4 | 126 | 56 | 225 |
| 9 | 5 | 126 | 70 | 180 |
| 9 | 6 | 84 | 56 | 150 |
| 10 | 4 | 210 | 84 | 250 |
| 10 | 5 | 252 | 126 | 200 |
| 10 | 6 | 210 | 126 | 167 |
| 11 | 4 | 330 | 120 | 275 |
| 11 | 5 | 462 | 210 | 220 |
| 11 | 6 | 462 | 252 | 184 |
| 12 | 4 | 495 | 165 | 300 |
| 12 | 5 | 792 | 330 | 240 |
| 12 | 6 | 924 | 462 | 200 |

## 1 - Choice of samples

- 6: Order of presentation of samples to the consumer
- The order in which the samples are presented to the consumers will depend on your experimental plan
- When there are $\mathbf{6}$ samples or less $\rightarrow$ Complete balanced plan: all the judges evaluate all the products
- When there are more than 6 samples $\rightarrow$ Incomplete balanced plan: each judge evaluates only part of the products

Excel Stat: enables you to set up different plans

## 1 - Choice of samples

- Order of presentation of samples to the consumer



## 1 - Choice of samples

- Order of presentation of samples to the consumer


## Example for 6 samples: Complete balanced plan

1
DOE for sensory data analysis
General $\mid$ Options $\mid$ Outputs


1: A new window opens.
2 : In the Products box: enter the number of samples you have. In this example 6

In the Products/assessors box: enter the number of samples to be tested by each consumer. In our case, 6 samples per consumer

In the assessors box: enter the number of consumers you are going to interview. In our case 125.

3 : Tick "Session 1" and "OK"

## 1 - Choice of samples

- Order of presentation of samples to the consumer


1: A new tab entitled "sensory design" opens in your Excel document.

## 1 - Choice of samples

- Order of presentation of samples to the consumer

$\rightarrow$ With this table (Assessors x Ranks table") you know in which order you should present the 6 samples to your 125 consumers.

2: Scroll down the document until you see the results entitled "Assessors x Ranks table" (line 179 in my example). In this table, each row corresponds to a consumer and the 6 columns give the order in which the samples will be tasted. For example, the first consumer (J1) will test the samples in this order: No. 1 first, then No. 3, then No. 6, then No. 5, then No. 2, then No. 4.

It's up to you to decide which sample corresponds to which number.

## 1 - Choice of samples

- Order of presentation of samples to the consumer


## Example for 10 samples: Incomplete balanced plan

$\rightarrow$ The procedure is the same when you have more samples to analyse.
$\rightarrow$ Example with 10 samples and 6 samples tasted by consumers
$\rightarrow$ How do I know how many assessors to enter in Excel? Refer to the table presented in this slide show (slide No. 23). In this example, a minimum of 167 people need to be interviewed to obtain at least 100 responses per sample.

| Numbers of <br> samples | Numbers of samples <br> tasted by consumers | Numbers of <br> combinations | Number of times samples <br> appear | Total number of consumers |
| :---: | :---: | :---: | :---: | :---: |
| 9 | 6 | 84 | 56 | 150 |
| 10 | 4 | 210 | 84 | 250 |
| 10 | 5 | 126 | 200 |  |
| 10 | 6 | 252 | 126 | 167 |
| 11 | 4 | 330 | 120 | 275 |
| 11 | 5 | 462 | 210 | 220 |

## 1 - Choice of samples

- Order of presentation of samples to the consumer


1 : In the "Products" box: 10 samples In the "Products/assessors" box: 6 samples to be tested by each consumer.

In the "Assessors box": 167 consumers are going to be interviewed

2 : Tick "Session 1" and "OK"

## 1 - Choice of samples

- Order of presentation of samples to the consumer

| Assessors x Ranks table: |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |  |  |
|  | R1 | R2 |  | R3 |  | R4 | R5 |
|  | P3 | P5 | P1 | P2 | P4 | P6 |  |
| J1 | P3 | P10 | P9 | P2 | P1 |  |  |
| J2 | P8 | P7 | P4 |  |  |  |  |
| J3 | P8 | P3 | P4 | P9 | P5 | P7 |  |
| J4 | P1 | P10 | P7 | P6 | P3 | P4 |  |
| J5 | P8 | P9 | P10 | P5 | P2 | P6 |  |
| J6 | P3 | P5 | P2 | P7 | P8 | P1 |  |

In this case of analysis there are 6 columns in the "Assessors x Range" table because we have asked each consumer to test 6 samples.

The first consumer will evaluate sample $n^{\circ} 3$, then 5 , then 1 , then 2 , then 4 and to finish $n^{\circ} 6$.
Judge $n^{\circ} 2$ will evaluate sample $n^{\circ} 8$ first, then $n^{\circ} 7$, then $n^{\circ} 10$, than $n^{\circ} 9$, then 2 and $n^{\circ} 1$.

## 1 - Choice of samples

- Order of presentation of samples to the consumer

| Order effect table: |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | R1 | R2 | R3 | R4 | R5 | R6 | total |
| P1 | 17 | 16 | 17 | 16 | 17 | 17 | 100 |
| P2 | 17 | 17 | 16 | 17 | 17 | 16 | 100 |
| P3 | 16 | 17 | 17 | 17 | 17 | 16 | 100 |
| P4 | 17 | 17 | 17 | 17 | 16 | 17 | 101 |
| P5 | 17 | 17 | 16 | 17 | 17 | 17 | 101 |
| P6 | 16 | 17 | 17 | 17 | 17 | 16 | 100 |
| P7 | 16 | 16 | 17 | 17 | 17 | 17 | 100 |
| P8 | 17 | 17 | 17 | 16 | 16 | 17 | 100 |
| P9 | 17 | 16 | 17 | 17 | 16 | 17 | 100 |
| P10 | 17 | 17 | 16 | 16 | 17 | 17 | 100 |

If you scroll down in the excel results you will find a table entitled "order effect table"(line 407) This table shows you the number of times each sample was tested in 1st, 2 nd, 3 rd, 4 th, 5 th or 6 th position.

In this example we can see that sample 1 was presented 17 times in first position, 16 times in second position, 17 times in third position, 16 times in fourth position, 17 times in fifth position and 17 times in sixth position. If we add up the number of times the sample was presented, we arrive at 100.

## 2 - Choice of sensory attributes

- The choice of sensory descriptors depends on the product studied
- Sensory attributes defined in RTBfoods product profiles
- 4 or 5 sensory attributes maximum
- Establish a clear definition list for selected attributes: if certain descriptors are poorly understood by consumers (because the definition is unclear or the word used for the descriptor is too complicated), the results risk being unusable


## 2 - Choice of sensory attributes

- Please note :
> The same descriptor may have different definitions depending on the country in which it is used. Example: sweetness. For some it will be the quantity of sugar, for others a sensation of sweetness
> Some descriptors are too specific and not known by consumers: for example, vitrosity.
> Some descriptors have definitions that are difficult to explain to consumers: for example, mealy.

If you have any questions or need help setting up your studies,

## See you soon for the next module



Thank you!

And Happy festive season !!


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