Retort effects

How does retorting affect wet petfood palatability?

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Sterilization is a critical step in the manufacture of wet petfood. Its aim is to guarantee the microbiological safety of products during their shelf life. Sterilization also has a great influence on flavor development (mainly through Maillard reactions) or off-flavor generation. Thus, sterilization is considered a key factor for wet petfood palatability.

This article will focus on a study that evaluated the influence of process parameters (time, temperature, sterilization value (F_0)) on the expression of a specific palatability enhancer (PE1) in a chunks-in-jelly cat food product, in terms of palatability. Consumption of Maillard precursors was measured as well. Correlation between palatability, process and chemical data was also carried out.

The palatability enhancer (PE1) used was a complex mix of Maillard precursors (amino acids and reducing sugars) together with other ingredients. The study used a wet petfood product containing 50% chunks and 50% jelly. The palatability enhancer was added to the jelly (2%; i.e., 1% of the total weight). The products were packaged in 100-g pouches.

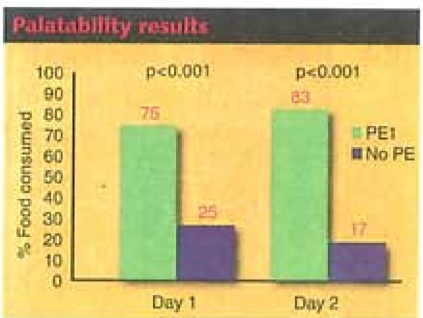

Figure 1. Palatability results: 1% PE1 (added to the gravy) vs. no PE in cat chunks-in-gravy retorted 127°C for 17 minutes (process 0).

Sterilization processes

Typical retorting processes of wet cat food range between 120°C and 130°C for 10 to 120 minutes, depending on product type, packaging type and size. As a starting point (process 0), performance of the palatability enhancer (PE1) added at 1% was measured versus no palatability enhancer retorted at 127°C for 17 minutes (see Figure 1). Consumption of product was higher ($p<0.001$) with the presence of PE1, demonstrating that proper palatability enhancers are a key factor for palatability of wet petfood.

Moreover, it was important in this study to find out how to improve the performance of the palatability enhancer by using different process conditions. Thus, an experimental design was created to evaluate the effects of processing. The process conditions tested are presented in Table 1. Sterilization values F_0 were recorded for each process within the core of the pouches. They were similar to theoretical F_0 (data not shown). Theoretical F_0 are shown in Figure 2. It is interesting to note that products 2, 3 and 4 underwent similar F_0 with different process conditions.

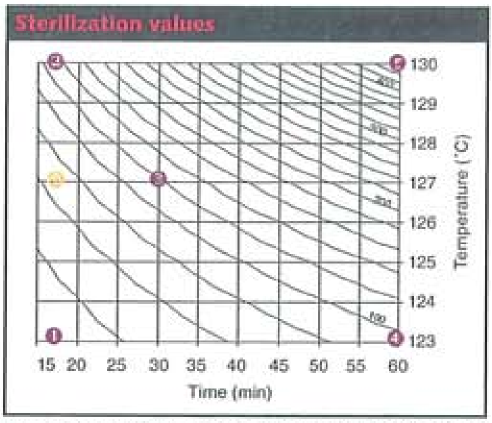

Figure 2. Iso-F_0 lines as a function of time and temperature. The process conditions tested (products 1 to 5) are shown on the chart, as well as process 0.

Levels of the remaining reducing sugars and free amino acids were also evaluated in the finished products. In particular, the concentrations of two amino acids (AA1 and AA2) and one reducing sugar (Sugar 1) were determined after the process.

Palatability testing

Palatability tests (two-bowl tests) were performed with 40 cats. Each process was tested versus all four other profiles, following a complete block de-

Process conditions

Table 1. Process conditions tested (products 1 to 5). Process 0 is presented for information.

Temp	17 min	30 min	60 min
123°C	1		4
127°C	0	3	
130°C	2		5

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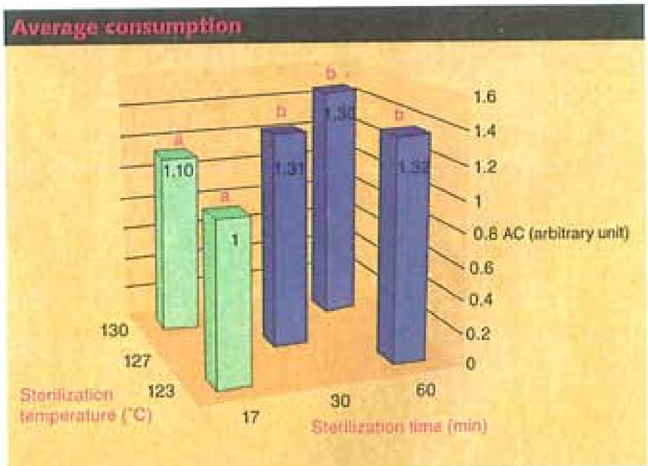

Figure 3. Average consumption (AC) of products as a function of process conditions. Arbitrary unit = 1 for the lowest consumption. Bars with different letters are statistically different ($p<0.05$).

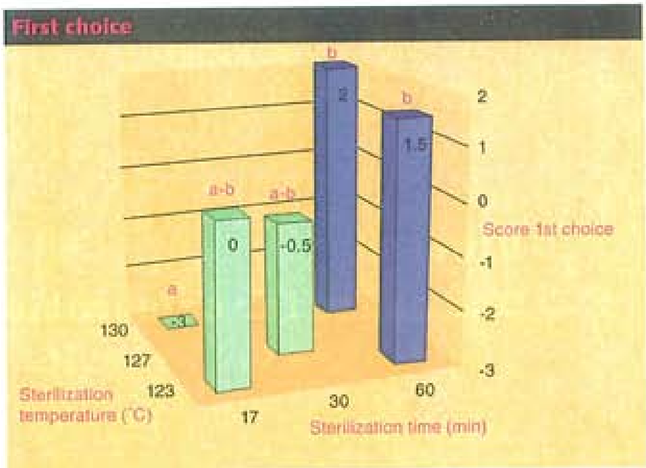

Figure 4. Scores first choice as a function of process conditions. Bars with different letters are statistically different ($p<0.05$).

sign. The following parameters were recorded (the first two are representative of palatability of the products):

- Level of significance for food consumption (student test);
- Average consumption of each product; and
- Level of significance for the first food chosen (Khi-two test; this parameter is related to the attractiveness of the products).

The average consumption per cat (AC) was calculated for each product. Means were compared through an analysis of variance (ANOVA). For each test, a mark between -3 and +3 was attributed to each product as a function of the level of significance for food consumption. For example, in a test of A versus B, if the consumption result was a significant difference ($p<0.001$) for product A, A received a +3 and B was -3. If the result was no significant difference, both products received a 0. The sum of marks for level of significance for food consumption was calculated for each product (the score significance). Scores were compared through ANOVA. The same system was applied to level of significance for the first food chosen (score first choice).

Process parameters do have an influence on the palatability of the chunks-in-gravy.

Differences between products

These calculations revealed a statistical difference ($p<0.05$) between average consumptions (AC) of products (see Figure 3). Two groups can be distinguished here. Products 3, 4 and 5 (retorted for the longest time) were the most palatable, whereas 1 and 2 were the least consumed. The same results were obtained with score significance (data not shown). It is interesting to note that products 2, 3 and 4 showed significant differences in terms of palatability, although they underwent the same F_0.

Similar results were obtained for score first choice (see Figure 4). Two groups can also be distinguished here: Product 2 (lowest score) and products 4 and 5 (highest scores). Products 1 and 3 show intermediate scores between the two groups. These scores are not significantly different from either groups ($p>0.05$). These results show that process parameters do have an influence on the palatability of the chunks-in-gravy.

Principal components analysis

A principal components analysis (PCA) was carried out next. This analysis allows products and variables to be represented in a multi-dimensional space. PCA allows us to establish similarities between products, as well as possible links between variables. Only palatability variables were active; therefore, products were placed in Figure 6 as a function of their level regarding palatability variables. All other variables were illustrative.

In Figure 5, two axes explain a 97.24% variability, and they are sufficient to allow relevant interpretations. Axis 1 (horizontal) demonstrates palatability and Axis 2 (vertical) explains two variables—attractiveness and palatability. Process time is positively correlated to Axis 1, whereas Sugar 1 and

Process effects

Table 2. p-values corresponding to the effects of process parameters on palatability and analytical data. Figures in boldface type represent significant effects ($p<0.05$).

	Avg. consumption	Score significance	Score 1st choice	AA1	AA2	Sugar 1
Temp (°C)	0.52	0.07	0.27	0.51	0.29	0.44
Time (min)	**0.013**	**0.0013**	**0.016**	0.85	**0.0500**	**0.0500**
Value (F_0)	0.17	**0.04**	0.19	0.90	0.69	0.49

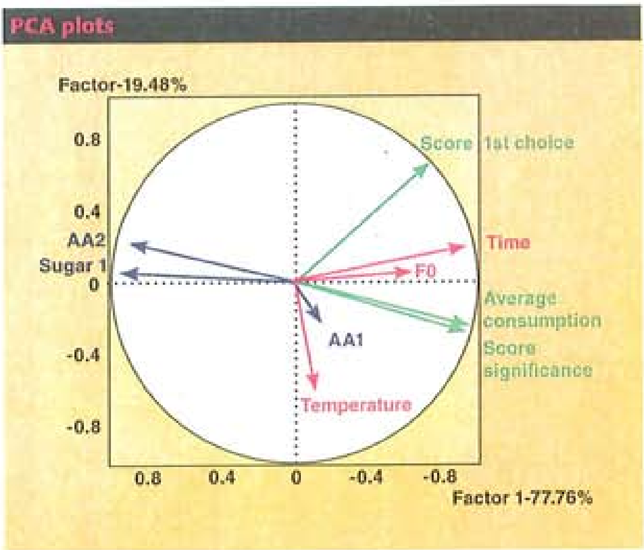

Figure 5. Principle component analysis (PCA) plots of variables. Active variables are palatability variables (in green). Illustrative variables = analytical variables (blue) and process variables (red).

AA2 concentrations are negatively correlated to Axis 1. The longer the process time, the higher the palatability and the lower Sugar 1 and AA2 concentrations. This is confirmed by ANOVA (see Table 2).

Results

Sterilization time has a significant effect on palatability and on Sugar 1 and AA2 concentrations. This shows that the most palatable products were the products in which Sugar 1 and AA2 were the most consumed during the process. As amino acids and reducing sugars are precursors of the Maillard reaction, they are consumed during the process and contribute to develop flavors, making the food more palatable and attractive. However, none of the process parameters has an influence on AA1, showing that this amino acid does not significantly undergo Maillard reactions.

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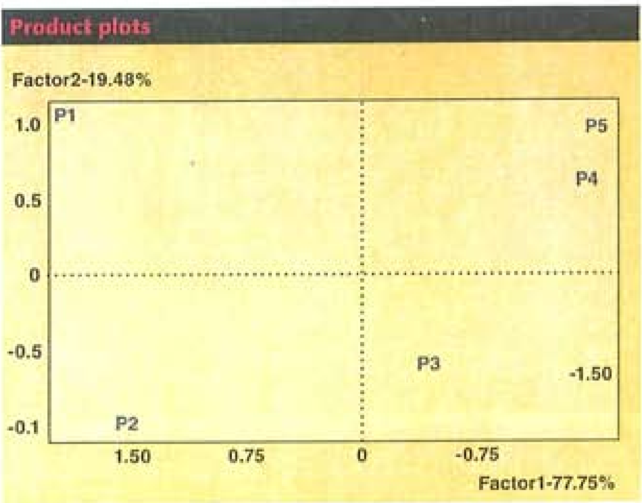

Figure 6. PCA plot of products.

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Sterilization temperature (in the selected range) does not show any significant effect ($p>0.05$) on palatability or analytical data. Sterilization value F_0 shows a significant effect ($p<0.05$) on score significance, but not on palatability or analytical data (see Table 2). P values show that the effects of F_0 on average consumption and score first choice (non-significant at $p<0.05$), must be considered ($0.17 \leq p \leq 0.19$). As F_0 can be considered as a combination of time and temperature, it seems logical to obtain P values that are intermediate between that of time and temperature.

The most palatable products were the products in which Sugar 1 and AA2 were the most consumed during the process.

In Figure 6, products on the right side of the chart are the most palatable. Products at the top of the chart are the most attractive and the most palatable. Products 4 and 5 (60-minute process) are the most attractive and the most palatable products, followed by products 3, 2 and 1. Based on these results, there is an evident link between process, formulation of palatability enhancers and palatability.

The use of a palatability enhancer is a key factor for palatability of wet petfood, but utilizing the best sterilization conditions an additional way to enhance palatability. In this specific case study, the best solution was to increase process time. Overall, this study proved that palatability of chunks-in-gravy containing 1% PE1 was improved when retorted at 123°C and 127°C for 30 to 60 minutes, when compared to the initial process conditions (at 127°C for 17 minutes).