# Process of "Epigenetic Regulation of Protein Synthesis" Tests in Panification

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During this talk, I will present to you various experiments which use a process whose application makes it possible to act on the fermentation of bakery yeast, using sequences of sonic waves.

**PLAN:** We will have, first of all, a presentation of the process, which will be followed by a presentation of the results of experiments.

## PRESENTATION OF THE PROCESS:

The use of music in agro-alimentary production is not new.
Malinovski in 1930 quoted farmers of the Pacific Islands which imitated songs of birds of their area, in order to improve the output of their crops (1).
These questions have just met a renewed interest: thus in Japan, the company "Gomeikaisha Takada" registered a patent on the use of selected music, played by various instruments, to improve fermentation of yeasts employed in the manufacture of soya sauce and miso paste (2).
Again in Japan, several companies of which the firm "Pioneer" and the industrial bakery "Shikishima Bread Co." currently finance research in this direction on various sectors: panification, production of alcohol and various food products. Their work aims at obtaining products being characterized by their outstanding taste. A product range, including in particular bread, was marketed since 1990 (3).

The process of "epigenetic regulation of protein synthesis", registered in June 1992 by Mr. Joel Sternheimer (4) proposes a means of stimulating or of inhibiting the synthesis of a specific protein: this action takes place by using a succession of sound waves whose physical frequencies and other characteristics are deduced from the amino-acids sequence of the considered protein.

I will remind to you, for example in the case of panary fermentation, that the stages which the bakery yeast uses to transform fermentable sugars into ethanol and carbonic gas ($CO_2$), principal fermentation products, are catalyzed by particular proteins: enzymes.

Each protein is characterized by its own sequence in amino-acids, which defines its three-dimensional form like its metabolic activity.
Very many proteinic sequences are known today, and available on various data banks (5).
Alcohol deshydrogenase or ADH, for example, catalyzes the biochemical reaction transforming acetaldehyde into ethanol; the acetaldehyde comes from the degradation of sugar, whereas the $CO_2$ release contributes to the swelling of the bread.
Starting from its amino-acids sequence, by applying the process, one obtains two types of sounds sequences, one being able to stimulate, the other being likely to inhibit the synthesis of the protein.

These sounds sequences, which thus form melodies of which the harmonic and rhythmic structures are remarkable, were diffused during the experiments that I will describe you, close to the lumps during fermentation.

## FIRST EXPERIMENT:

The first experiment was carried out on two round loaves of bread made from the same lump of paste.

Throughout fermentation, I broadcasted, using a walkman with continuous run (auto-reverse Walkman) connected on loudspeakers, the musical transpositions of the ADH in stimulation and inhibition on each of the two breads taken separately.
After cooking and cooling, the two breads were characterized mainly by their difference in taste. The bread having received the transposition of the ADH in inhibition had a strong rancid taste, which was accentuated the following days, contrary to the other.
It thus seemed that in addition to have highlighted the effect of the music on the activity of yeasts of bakery, one checked the specificity of their action with respect to the selected enzyme. One can indeed correlate this strong rancid taste with an accumulation of acetaldehyde resulting from the inhibition of its transformation into ethanol.

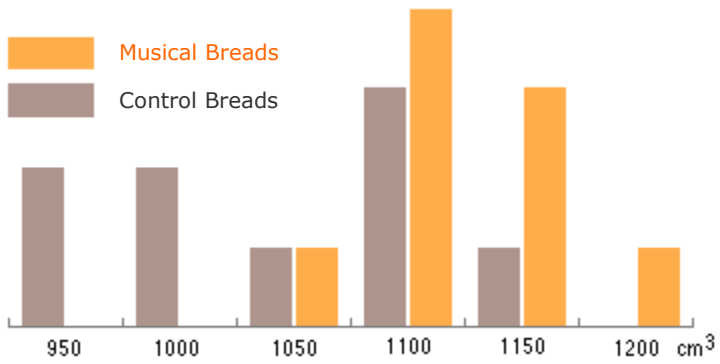
This first result encouraged us to continue our tests, in particular with the assistance of Mr. Philippe Roussel in the panification laboratory of ENSMIC.

**SECOND SERIES OF EXPERIMENTS:**

The two tests, which will follow, were thus carried out within the panification laboratory of the school.
We used a manufacture diagram of “standard French” bread, with intensified kneading. For each test, we use the same kneader. The lumps obtained, after shaping, were divided into two homogeneous batches by their rheological composition and their characteristics, a “pilot” batch and a “musical” batch.
We had two fermentation chambers regulated with the same temperature and moisture conditions, one of them including the same musical broadcasting equipment quoted previously. The two batches were placed respectively in each of the two rooms, the musical batch receiving the musical transposition of the ADH in stimulation.
After cooking and cooling under the same conditions, the volume of each bread was measured using a grain volumeter.

The following graph gives an account of the results obtained on the first test, on a total of 2 times 10 breads, for the fermentation duration of 1:45:

Distribution of volumes of breads

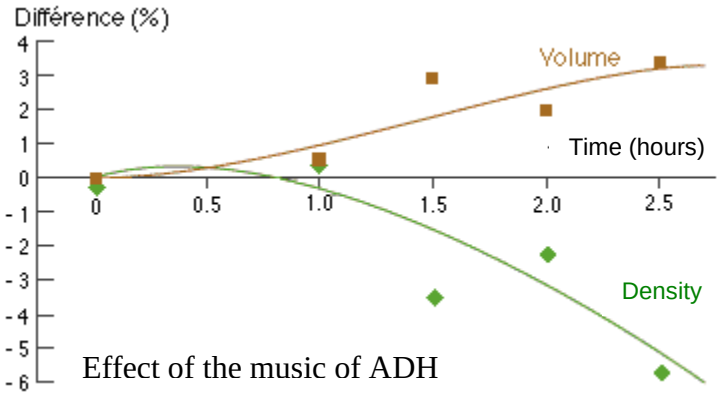



In X-coordinate, we gathered by classes the volumes of breads (in $cm^3$), the height of the columns is proportional to the numbers of breads.
On this graph it is interesting to note, first of all, the difference in distribution between the two batches. The dispersion of the “musical” batch was more than twice lower than that of the “witness”, which shows a greater homogeneity of the musical batch.

Moreover, it was noted a significant difference in volume: the average volume of the “musical” batch seeming a little more important than that of the “control” batch by approximately 6%.

A statistical analysis of the data collected on this test makes it possible to calculate a significance of 2.7 standard deviation, thus a probability lower than 1% that the effect observed is due to random.

A second test was carried out on, this time, 2 times 36 breads, the following curve giving an account of the results observed:

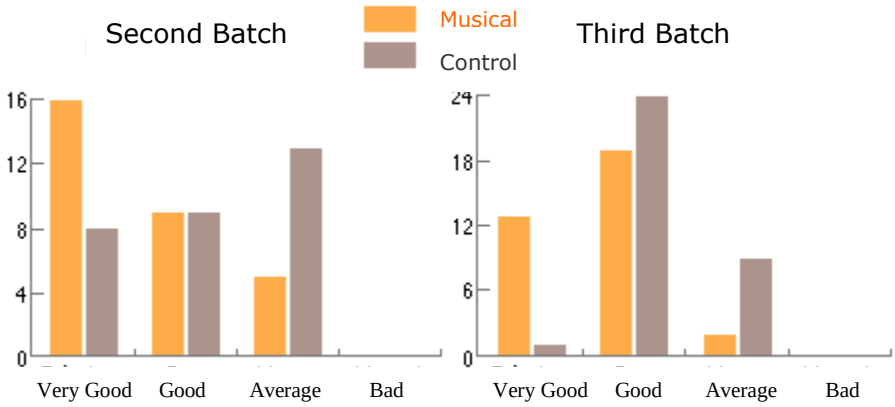


Effect of the music of ADH

The breads were divided into eight homogeneous batches, four with music of the ADH, and four without (being used as control). On these two groups, we took analysis samples for fermentation times of 1 hour, 1:30, 2:00 and 2:30, in order to observe the differences between the musical batches and the control during time.
On this curve, we noted the differences of volumes, and densities (weight/volumes) between the two batches. One notes here still a difference, which increases with time. The “musical” breads appear with a volume higher than the “controls”, which is confirmed by a lower density.

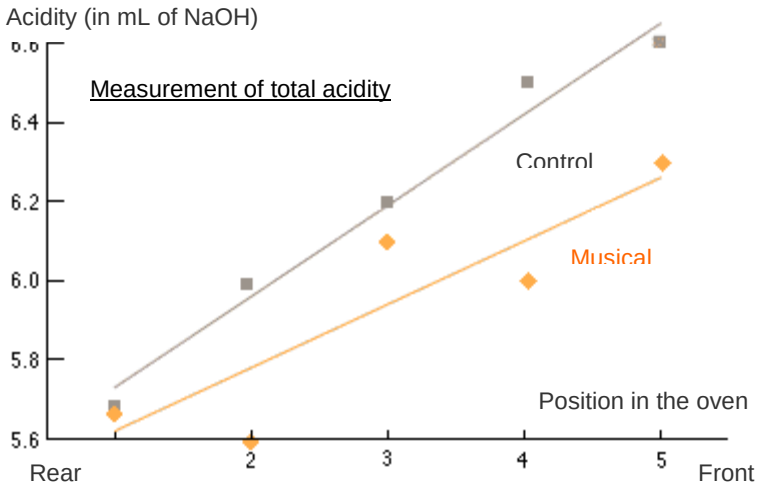
In order to go further on this point, we are currently carrying out tests on a manufacture of “leavened bread”, for bakeries “Poilâne”. We base our analysis on the one hand on tasting panels and, on the other hand, on the measure of acidity variations (pH, titration of total acidity) resulting from the application of the process. The broadcasted musical transposition is that of the ADH supplemented by that of maltase of bakery yeast.

The two following graphs show results obtained on two “tasting panels”:




On about thirty people having taken part in each test (in ordinate we have the numbers of people), one sees appearing a clear preference of taste for the “musical breads”.

The curve below makes it possible to compare the acidity variations between a “musical” batch and a “pilot” batch. It is based on the measure of acidity by neutralization by soda (quoted in millilitres):




One sees, on this curve, an increase in acidity for the two batches, between the series “1” to “5”, corresponding to the difference in fermentation time that there was between the first worked breads and the last. But it is especially interesting to notice a systematic fall of acidity between the “musical” breads and the “controls”.

I thank you for your attention, and hope to communicate new results to you on next ENSMIC Technical Days.

Various documents concerning experiments undertaken in panification but also in agriculture are available.

**References:**

1) Malinovski (1930), quoted by P. Weinberger & U. Graefe in "The effect of variable-frequency sounds on plant growth", published in the Canadian Journal of Botany, 51, pp.1851-1856 (1973).

2) Takada Shoten & Sigeru Takada, "Production of brewed food sending music with various wavelength", patent application H3-224462 (1991).

3) Article published in the Japanese newspaper ASAHI SHIMBUN (Tokyo) on 23 July 1993.

4) Joël Sternheimer, "Process of epigenetic regulation of the protein synthesis ", French patent application nb. 92-06765 (June 1992).

5) NBRF Data Bank, W. Barker, National Biomedical Research Foundation, Georgetown University, Medical Center, 3900 Reservoir Road, Washington D.C. 20007, USA.