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The evolution of the microbial population during pickling process

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Abstract

In order to observe the growing rhythm of the microbial population the working alternatives, completely studied from the organoleptic and physical-chemical point of view, have been repeated. These alternatives had the folowing variations:

- *the preliminary thermal treatment (the use of the fresh or blanched cucumbers –at 77°C for 3 min.)*
- *the composition of brines, using the "clean" traditional brine with a 6% concentration of salt and brines with conservers (Na benzoate 0,25%, Ca lactate 0,25%, acetilsalicilic acid 0,05% plus a concentration of 2% or 4% NaCl).*

From the point of view of the growth of microbial population, the alternatives without conservers as well as the blanched ones had a good results.

Keywords*:* cucumbers, lactic fermentation, microbiological stability

Introduction

The traditional process of pickling used NaCl as the sole conserver; during the fermentation process the lactic acid will be produced as well as a series of other secondary products (acetic acid, etc) ending the conservation action of salt.

The industrial production of this range of products has been based lately on the use of brines with acetic acid in different scales followed by variable concentrations of salt and other various conservers.

Bell and Etehells, 1961 [1], used bigger concentrations of salt (8-16%) in the case of some classical brines with NaCl as a sole conserver; they motivated this as ensuring the microbiological stability, prevent from enzymatic softening and protecting against freeze damage in frigid climates.

Novaceanu, 1978 [13], showed that at a 4-5% NaCl concentration, cucumbers are not to be preserved at temperatures of 5-18 °C and after 21-st of March.

Simultaneously with the tendency of reducing the NaCl conservation, different conservers were adding in different concentrations.

The use of $CaCl_2$ in the pickling process was applied by many authors (Fleming-1987 [7], Buescher-1986 [4], Durkee, Lowe and others), claimed that the most important advantage is the enzymatic protection, ensuring the protection against the softening cucumbers.

Fleming, 1996 [8], adds Na benzoate, 0,1% at the end of fermentation for some of the alternatives, and he noticed its positive result for the microbiological stability. When this is used, the propionic acid is not formed during storage at a pH lower than 3,3, and butyric acid is not formed at a pH lower than 3,7.

One should take into consideration the Na benzoate influence upon the taste distortion, especially when it is preserved over a longer period of time.

Material and method

Fresh cucumbers of Cornichon type, *Ira* hybrid, have been used and came from Pipera greenhouses Bucharest (Romania). They were part of the 6,1-9 cm length category according to STAS SR 14/6-1996 [14]. Cucumbers which were selected for the experiment (fresh, not notables dessicated, with no mechanical damage) were washed in renning water.

Two procedures were applied: with blanching (70 °C/3 min.) followed by cooling down to 40 °C, under water jet and with no blanching.

Brine variants that were used in each procedure are shown in table 1.

The lactic fermentation process took place in jars of 750 ml, with "Twist-off" closing system. After ordering the cucumbers and adding spices, brine (boiled and cooled at about 20°C), the fermentation pots were completely closed. The jars were stirred periodical so that the liquid could be homogeneous.

Table 1. Technological alternatives used

Hybrid	Alternative	Technology Used	Fermentation temperature	Brine recipe
IRA	IP1	Fresh cucumbers (unblanched)	15-19ºC	2% NaCl + 0.55% additives
	IP2			4% NaCl + 0.55% additives
	IP3			6% NaCl
	IO1	Blanched cucumbers		2% NaCl + 0.55% additives
	IO2			4% NaCl + 0.555 additives
	IO3			6% NaCl

Additives in all the alternatives that are supposed to contain them were added in the following proportions: 0,25% Ca lactate, 0,25% Na benzoate and 0,05% acetylsalicylic acid.

The fermentation temperatures were those currently used in laboratory conditions, namely 15-19°C.

During the fermentation followed the pH, the acidity and microbian charge. This last determination was effectuated through modern method – based on the establishing of optic density with the spectrophotometer.

Results and Discussions

Establishing the growth of microbian population through the spectrophotometric method, observed that microbian population from variants IP1 and IO1 have a short "lag" stage (growth 0), while in the stagnation stage have a longer times than other variants. The variant IO1 have turbidity greater than variant IP1.

With variants IP2 and IO2 observed that "lag" stage last longer than usually because of conservers at that adding a concentration from 4% NaCl, who prevent growth of microorganisms. In case of variant IP2 the stagnation stage is very short, while the logaritmic stage last 6-12 days. The variant IO2 have turbidity grater than variant IP2, but lower than variant IO1.

The variants IP3 and IO3 have been analysing comparable and observed that the stagnation stage of IP3 is much longer than variant IO3 and last 4-5 days. The tests of variant IO3 characterize through the "lag" stage very short (the fermentation process, and therefore the growth of microbian population, is faster).

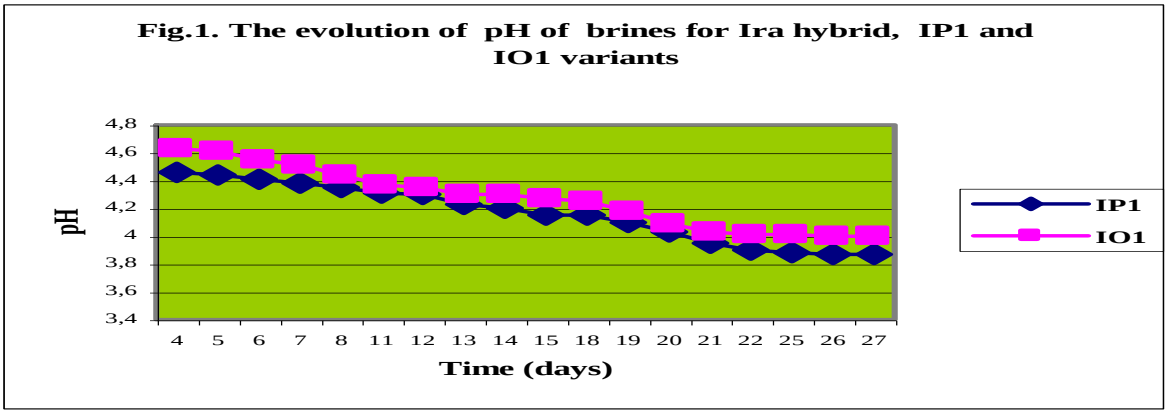
It was find out that variant IP2 have initial a cellular density lower than variants IP3 and IP1. To end of experiment, the variant IP3 prove to be richer in microorganisms than other variants from type P.

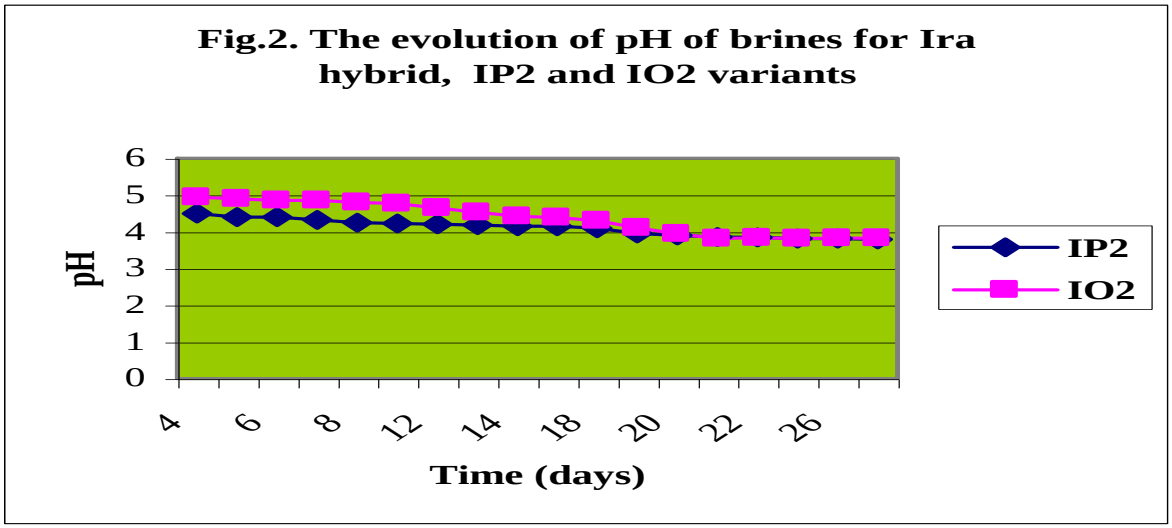
In case of variants from type O, the variant IO3 present initial the greatest turbidity and visible the greatest number of cells, following the variants IO1 and IO2. But to end, the maximum cells density is present to variant IO3. The variants from type O present always a microbian density greater than variants from type P (table 2).

Table 2. The optic density read on the distance of fermentation process, to the variants of *Ira* hybrid

Day / Var.	**4**	**5**	**6**	**7**	**8**	**11**	**12**	**13**	**14**	**15**	**18**	**19**	**20**	**21**	**22**	**25**	**26**	**27**
IP1	0,18	0,22	0,24	0,26	0,26	0,26	0,29	0,34	0,36	0,37	0,36	0,32	0,27	0,23	0,24	0,26	0,24	0,24
IP2	0,06	0,09	0,09	0,09	0,08	0,07	0,19	0,24	0,3	0,34	0,37	0,38	0,30	0,26	0,28	0,24	0,29	0,30
IP3	0,15	0,19	0,23	0,25	0,27	0,40	0,44	0,46	0,47	0,50	0,46	0,52	0,48	0,43	0,48	0,38	0,55	0,39
IO1	0,03	0,03	0,06	0,08	0,1	0,12	0,17	0,23	0,29	0,36	0,42	0,46	0,45	0,41	0,40	0,37	0,35	0,34
IO2	0,06	0,09	0,10	0,12	0,14	0,25	0,3	0,35	0,43	0,44	0,46	0,46	0,41	0,39	0,35	0,33	0,33	0,32
IO3	0,19	0,21	0,25	0,29	0,33	0,37	0,44	0,47	0,53	0,57	0,63	0,66	0,60	0,57	0,55	0,53	0,51	0,51

Scalding has an influence on the growth of the microbiological population. As you can see from chart no. 2, following the IP1 and IO2 variants, we can see a difficult start in the fermentation for IO1 variant (a prolonged "lag" phase). The explication would be that the spontaneous microflora left after washing for the not scalded variants have a favourable contribution to the start of the fermentative process. We could say that we may have a "partially controlled" fermentation through scalding, but for the first results (higher pH values, of 4,63 and 4,94, corresponding to low acidities-from 0,39 and 0,25%) we cannot speak about a promising start (figures 1 and 2).





Once the fermentation has started, the microorganisms have a serious growth (the fermentation is very powerful owing to the powerful osmose – which is favoured by the scalding process). Following the evolution of the acidity during the fermentation, we can see the same values for the two variants (scalded and not scalded) and even higher values at the end of the process for the scalded variants IO3 (1,15%), IO2 (1,03%) versus the not scalded ones IP3 (0,99%) and IP2 (0,89%) (figures 3 and 4).

Besides scalding, the conserver substances also have a contribution to the slow rhythm of the microorganisms growth at the beginning of the process. Thus, for the variants without conservers (IP3 and IO3) the "start" is almost identical, maybe even better for IO3 .

Irrespective of the starting rhythm, which is influenced by the pickle composition, the scalded variants have a larger microbiological density, owed to the powerful processes of osmose.

Fig.3. Dynamic of total acidity for brines of IP1, IP2 and IP3 variants of the *Ira* hybrid

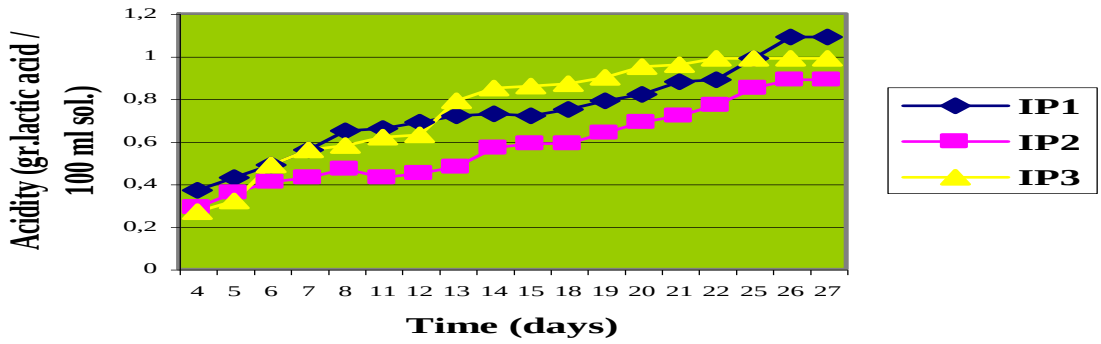
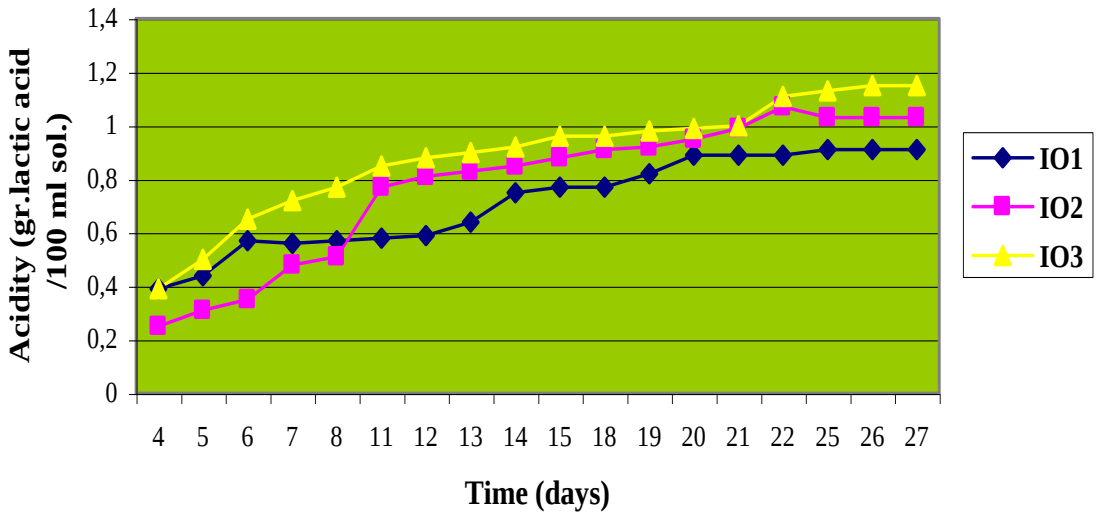


Fig. 4. Dynamic of total acidity for brines of IO1, IO2 and IO3 variants of the *Ira* hybrid



Conclusion

Technological variants with no previous blanching yield have better results from the organoleptical point of view (good-looking fermented cucumbers, bright colour, good firmness, no holes in the core, agreeable taste and flavour).

Conservers, such as Na benzoate, acetilsalicilic acid, can secure a good microbiological stability during the fermentation, preventing ill-timed pollutions with microorganism of different kinds. Their presence, together with NaCl, is supposed to decelerate the process of fermentation, bringing about a stagnation that will have an ill effect on the finished product, especially with the long-term preservation; the most remarkable consequence of it is an insipid taste associated to the reek of conserver (pungent or petrol-like).

These can affect the growing rhythm of the microbial population by making it develop in a slower way, thus simple brines are to be preferred. P2 and O2 types of variants have a difficult start in fermentation and a longer "lag" stage. P1 and O1 types of variants have a longer stagnation stage. In this case, the logarithmic stage is also longer (6-12 days) which leads to a continuation of the contact with preservers, with unpleasant taste, leading automatically to a longer process, until the finished product is obtained.

The use of Ca lactate has a beneficial effect, conferring firmness on the fermented vegetables, which is highly appreciated by the consumers.

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