# REDOX ASPECTS REGARDING PRESERVATION OF VEGETAL FOOD PRODUCTS BY FREEZING

CRISTINEL V. ZĂNOAGĂ[1*], MĂDĂLINA ZĂNOAGĂ[2], MARIUS NECULAU[1]

**Key words:** food products, freezing, vegetal products, redox characteristics

**Abstract**: Freezing, at least of the vegetable products, no matter of the anatomic part involved – root, stalk, leaf, flower, fruit or seed – induces a biochemical changes manifested, implicitly, by modification of the tissular rH. More precisely, the more distant the native rH of the product under consideration is from a certain value – apparently the optimum/compatible to the animal, consuming organism – (rH ~ 26), the deeper are the transformations it suffers as a result of freezing, namely: if the native rH takes values below 26, the product gets oxidized by freezing while, in the opposite case, it is reduced, as if the whole group of vegetal products would tend to attain – by means of freezing – a (redox) homeostasis.

## INTRODUCTION

Freezing is a widely used method for preserving animal or vegetable products. In the case of vegetables, which are characterized by doubling of the cell membrane with a rigid cell wall, freezing may lead to breaking of the latter and, consequently, to biochemical changes. A possible working assumption would consider, too, this kind of changes which could appear not only in animal tissues but also in derivated products, such as cheese (a case in which tertiary- and especially quaternary-type structural changes may be invoked, at least in the case of proteins). A somehow exhaustive study, i.e. applied not only to currently frozen products but also to other types, is now being initiated with this first work.

## MATERIALS AND METHODS

Various vegetal products, of all anatomic origins – root, stalk, leaf, flower, fruit, seed – have been frozen and then defrozen, with a 24 hours interval of time, as a pause between them, for assuring the necesarry time for evidencing the biochemical progress provoked by the change induced in the cellular and macromolecular structure by freezing. An aliquote product mass has been preserved in refrigerate state as control. Both samples have been then frozen for preservation up to the moment of characterization (the more so that the selected characterization method itself includes as a mandatory stage a freezing-defreezing cycle aimed at distrupting the supramolecular/infracellular and cellular structures, and at releasing the constituent substances). For biochemical characterization, a global parameter, namely the redox character, has been choosen, (if considering, too, that the biological processes those occurring inside the consumer's body included, are strongly influenced by this parameter [1]). The method applied, of the electrometric type, has been described in detail elsewhere [2]. The data obtained are shown in Table 1.

## RESULTS AND DISCUSSION

One may observe that, in many cases, freezing induces a rH change, although no generally valid direction can be established. However, by plotting graphically the difference between the native rH (rH) and the rH ($rH_p$) acquired, after the freezing-defreezing stage, namely ΔrH, as a function of the native rH (Figure 1) – on may observe that the farther is the native rH from a certain value, the higher is the change in the product's biochemistry following the preservation stage (Figure 1 does not include all data presented in Table 1, but only part of them, randomly selected).

Table 1

| Organ | Species | rH | $rH_p$ | $\Delta rH = rH - rH_p$ |
|---|---|---|---|---|
| Root | Radish | 14.835 | 19.58 | –4.745 |
| | Carrot | 25.975 | 27.25 | –1.275 |
| | Parsnip | 25.23 | 26.96 | –1.730 |
| | Parsley | 30.24 | 29.69 | 0.550 |

| Organ | Species | rH | $rH_p$ | $\Delta rH = rH - rH_p$ |
|---|---|---|---|---|
| | Red beet | 29.90 | 29.69 | 0.210 |
| Stalk | Potato | 26.05 | 27.38 | –1.330 |
| | Kohlrabi | 20.31 | 23.44 | –3.130 |
| | Cabbage | 20.31 | 23.14 | –2.830 |
| | *Helianthus tuberosus* | 22.11 | 29.82 | –7.710 |
| Leaf | Lovage | 26.62 | 25.58 | 1.040 |
| | Dandelion | 32.03 | 26.59 | 5.440 |
| | Nettle | 22.31 | 28.25 | –5.940 |
| | *Atriplex hortensis* | 30.225 | 23.84 | 6.385 |
| | *Rumex patientia* | 24.25 | 24.13 | 0.120 |
| | Lettuce | 22.62 | 24.525 | –1.905 |
| | Cabbage | 21.94 | 23.87 | –1.930 |
| | Onion (bulb) | 29.02 | 25.66 | 3.360 |
| | beet | 18.60 | 27.34 | –8.740 |
| | *Allium porum* | 29.94 | 30.14 | –0.200 |
| | Leek | 25.54 | 21.48 | 4.060 |
| | Spinach | 28.19 | 29.78 | –1.590 |
| | Celery | 29.05 | 29.05 | 0.000 |
| Flower | Acacia | 29.18 | 26.47 | 2.710 |
| | Rose | 26.45 | 28.65 | –2.200 |
| | Cauliflower | 22.85 | 25.50 | –2.650 |
| Fruit | Strawberry | 24.36 | 24.64 | –0.280 |
| | *Cerasus avium* | 22.24 | 25.43 | –3.190 |
| | Raspberry | 24.85 | 25.57 | –0.720 |
| | *Cerasus vulgaris* | 22.27 | 27.00 | –4.730 |
| | Gooseberry | 27.73 | 26.29 | 1.440 |
| | *Prunus cerasifera* | 23.52 | 27.02 | –3.500 |
| | Beans (pod) | 27.605 | 24.48 | 3.125 |
| | Tomato | 22.29 | 20.49 | 1.800 |
| | *Pirus comunis* | 31.51 | 21.14 | 10.370 |
| | *Prunus domestica* | 34.42 | 32.29 | 2.130 |
| | *Persica vulgaris* | 32.47 | 31.60 | 0.870 |
| | European grape vine | 32.21 | 28.66 | 3.550 |
| | Pepper | 25.96 | 23.795 | 2.165 |
| | American grape vine | 29.24 | 32.00 | –2.760 |
| | Wild rose | 23.39 | 23.715 | –0.325 |
| | Cucumber | 22.02 | 30.215 | –8.195 |
| | Vegetable marrow | 32.43 | 21.09 | 11.340 |
| | Apple tree | 24.245 | 27.255 | –3.010 |
| Seed | Pea (green) | 19.15 | 19.87 | –0.720 |
| | Horse bean (green) | 25.84 | 24.54 | 1.300 |
| | Beans (green) | 30.79 | 26.45 | 4.340 |
| | Walnut tree | 26.32 | 27.29 | –0.970 |

| Organ | Species | rH | $rH_p$ | $\Delta rH = rH - rH_p$ |
|---|---|---|---|---|
| | Peanut | 12.18 | 25.01 | –18.830 |

In other words, for a reductive deviation of the rH, freezing induces oxidation, and respectively, reduction, for its oxidative deviation, as if on the whole, the vegetal products would manifest a liking towards (global) homeostasis. This is represented by emphasizing of a straight line (the dotted one) whose crossing the abscisa would be the rH value (rH ~26) of global homeostasis. It is especially interesting that the animal tissue, particularly the human tissue, is globally characterized by this rH value.

Anyway, it is obvious that with the exception of the vegetal products characterized by rH values closest to 26, for all the others, preservation by freezing is inappropriate. Consequently, two different attitudes are therefore possible:

1. Selection, in view of preservation, of the vegetal products, by rH determination, and, consequently, freezing exclusively of products with rH values close to 26
2. Utilization of the frozen product as soon as possible, even its cooking in frozen state, for avoiding its defreezing.

However, as previously shown [1], a certain dependence of the gustative characteristics on the rH of the product is manifesting so that a certain taste depreciation of the product preserved by freezing cannot be ignored, even if its nutritional properties remain unchanged.

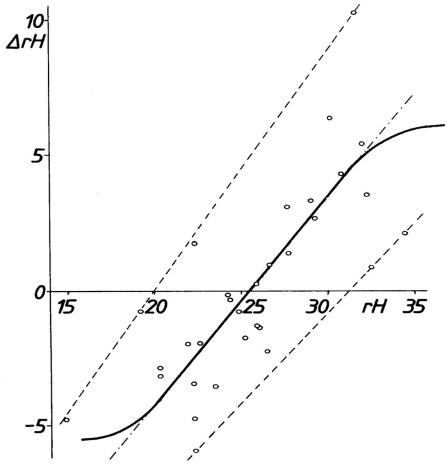


Fig. 1. The straight line resulting from the interpretation of the experimental data is only apparent, as the values recorded on the abscisa cannot exceed limits 0 and respectively, 42.4, beyond which the notion of rH looses its physical meaning. Therefore, one may be entitled to admit/support the tendency – manifested by the dependence for the extreme rH values (the continuous line) – of the distribution level.

## CONCLUSIONS

Freezing induces a biochemical changes, quantificable by tissular rH. Thus, the more distant the native rH of the product under considerations is from a certain value (rH ~ 26) the deeper are the transformations it suffers: if the native rH takes values below 26, the product get oxidizing by freezing while in the opposite case it is reduced, as if the product would tend to obtain the same statement with other like-products.

## REFERENCES

1. Duca G., Zănoagă C. V., Duca Maria, Gladchi Viorica, 2001, *Procese redox în mediul ambiant*, Ed. Universității de Stat din Moldova, Chişinău.
2. Zănoagă C. V., Neacşu I., Zănoagă Mădălina, *St. cerc. biochim*., 31, 1, 1988, p. 53-58

[1]Academy of Romania – Center for oenological researches of Jassy
[2]Institute of Macromolecular Chemistry "P. Poni" Jassy
*cvzanoaga@yahoo.com