BREATHING ACTIVITY OF STR.FAECALIS UNDER THE INFLUENCE OF SOME SUBSTRATES PRESENT IN MEAT PRODUCTS

M.Stoychev, G.Djejeva

Meat Technology,Research and Project Institute,Sofia

The sugar and ascorbic acid added in the production of meat products and the lactic acid formed during meat ageing, storage and processing can be used as substrates by specific microflora.

The sugar applied in the manufacture of meat products in the amount of 0,1 to 0,3%, and in brine cure in the amount of up to 1,0%, serves as a medium for the growth of microorganisms, including enterococci.

The process of anaerobic enzymatic destruction of glucose (glycolysis) beginning with phosphorylation and the formation of glucoso-6-phosphate, then, as a result of a number of consecutive reactions, forming ATP, 2-phosphoglyceric and pyruvic acids, has a great biological significance for the growth of microorganisms. As a result of the destruction of carbohydrates, high-energy phosphorus compounds and substances are formed, which are utilized by microorganisms for biosynthesis, and are also basic substrates in oxidative processes (1,2).

The process of carbohydrate transformation during meat ageing, unlike the process taking place in living muscles, is irreversible. Glycogen, by means of a number of intermediate reactions, is transformed into lactic acid that accumulates in meat in the amount of 320 to 660 mg% (depending on the duration of meat ageing) and has a significant role in the process of meat ageing (5).

A number of authors assume that the presence of lactic acid is an unfavourable factor for the growth of microorganisms, in consequence of the occurrence of a more acidic reaction of the medium.

Ascorbic acid is often made use of in meat processing, as its salts provide for the better formation of N-myoglobin, and the colour intensity of meat products depends on the presence of the latter. Data on the utilization of ascorbic acid as a substrate by some microorganisms are available in literature. The note on the stimulating action of ascorbic acid on the growth of Str. faecalis R. both in the presence and in the absence of folic acid presents considerable interest. The oxidation and regeneration products of folic acid have no pronounced action with regard to the growth of Str. faecalis R. (3).

The objective of the present work is the study of the breath-

ing activity of Str. faecalis using glucose, lactic acid and ascorbic acid, in concentrations typical for meat products, as substrates.

METHODS

The studies were carried out by use of a suspension of a 6 hr. culture of Str. faecalis var. liquefaciens strain 755. The biomass was separated from the liquid medium (3) by centrifugation and double washing with physiological solution (6).

The breathing activity of the cell suspensions of Str. faecalis was determined using Warburg's apparatus, according to the amount of oxygen consumed, in the following conditions: a temperature of 28±0,1°C; gas phase, air; total volume, 3,2 ml; pH, 7,4; amount of suspension in the system, 0,8-1,0 mg by the carbon. Carbon dioxide was consumed by 0,2 ml of 20% KOH solution placed in the central vessel. The rate of oxygen consumption was expressed in mm^3 of O_2 used in 1 hour per 1 mg of cellular carbon.

In the study of the oxidative capacity of Str. faecalis, substrates were utilized which upon dilution in Warburg's vessel corresponded to the following concentrations: glucose, 0,1% (corresponding to its content in meat products) and 1,0% (in brine cures); lactic acid, 0,5%; and ascorbic acid, 0,02%.

The model solution represented a combination of the substrates studied in the same concentrations, and substances with inhibitory action in ratios and amounts contained in meat products: $NaNO_3$, 0,025%; $NaNO_2$, 0,0125%; NaCl, 1,8%; and $Na_4P_2O_7 \cdot 10\ H_2O$, 0,3%.

RESULTS AND DISCUSSION

Data from the investigations carried out of the breathing activity of Str. faecalis using glucose, lactic acid, ascorbic acid and model solution as substrates, are shown in Graph 1.

The results obtained indicate that a different oxidation rate of particular substrates is observed. The oxidation rate is highest with the glucose substrate, followed by those with lactic acid and the model solution. A linear relationship is established between the amount of axygen consumed and the time of oxidation, irrespective of the substrate used.

Ascorbic acid proves a weak substrate in the exogenous breathing of Str. faecalis. Its action can rather be accepted to be stimulating its endogenous breathing. These results give us grounds to assume that ascorbic acid is practically preserved in the exogenous breathing of Str. faecalis what ensures its action of a colour stabilizer in meat products.

The lactic acid formed serves as a subsrate in the breathing of Str. faecalis and may take part in the creation of favourable conditions for its growth.

In the model solution, the presence of inhibiting substances reduces nearly twice the oxidative capacity of Str, faecalis with the same substrates, which proves their preservative action in meat products.

The results revealing the good utilization of glucose and lactic acid, in amounts contained in meat products, as substrates in the exogenous breathing of Str. faecalis prove their favourable role for the growth of enterococci and other specific microflora in meat products, which is essential in the production and hygienic evaluation of the latter. The data on the insignificant utilization in the exogenous breathing of Str. faecalis of ascorbic acid in quantities applied in meat processing prove that enterococci do not decompose it, its quantity in the product is preserved, so its action of a colour stabilizer of meat products is not diminished. These results are also of a great theoretical and practical importance for production.

CONCLUSIONS

1. Glucose, in a quantity corresponding to added sugar in meat products, serves as a substrate with which Str. faecalis shows the highest oxidation rate;

2. Lactic acid in a quantity, corresponding to that formed during the ageing of meat and meat products, also serves as a substrate with which the oxidation rate of Str. faecalis is lower, but close to that with glucose;

3. The application of glucose and lactic acid as substrates in quantities contained in meat products proves their favourable role for the growth of enterococci and other specific microflora, which is of importance in production and hygienic evaluation;

4. Practically no oxidation of ascorbic acid, in quantities applied in meat processing, is established in the exogenous breathing of Str. faecalis, and its action is assumed to be stimulating the endogenous breathing of the strain under investigation, its participation in colour stabilization of meat products being thereby preserved;

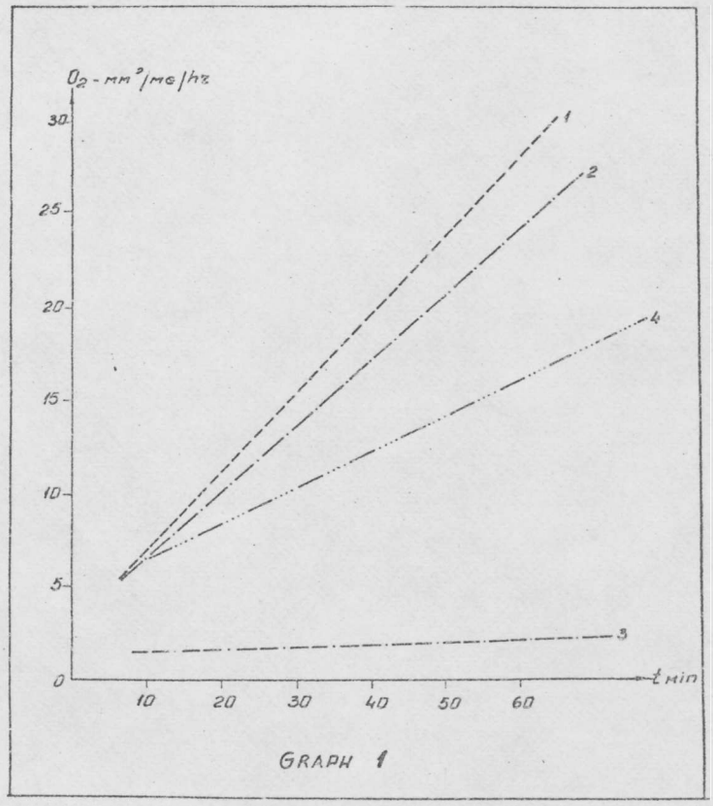
5. In a model solution containing substrates and substances of inhibitory action, the oxidative capacity of Str. faecalis is reduced nearly twice, their importance of preservatives in meat products being demonstrated in this way;

D6

6. A linear relationship has also been demonstrated between the amount of oxygen consumed and oxidation time with all the substrates applied and the model solution.

Literature

1. Bezborodov A.M. - Biosyntez Biologicheski activnich veshtestv Microorganismami, Leningrad, 1969
2. Chorreker B.L. - Trudy V Mejdunarodnogo Biochimicheskogo Comgressa. Symposium III, Moskva, 1962
3. Houtsmuller U.M.T., L.L.van Deenen - Biochim. et Biophys.Acta 1965, 106, p.564
4. Jaquet J., Huynh.Cng.Han., "Ann.falsific. et expert.Chim.", 1967, 60, N°677, p.295-316
5. Krilova N.N., Liaskovskaia U.N. - Biochimia Miasa, Pishtevaia Promishlenost, Moskva, 1968
6. Stoychev M., G.Djejeva, R.Ilieva - Influence of some Pasteurization Temperatures on the Dynamics of Evolution and Breathing Activity of Str.faecalis - paper - 17th Meeting Meat Res.Workers, Bristol, 1971



GRAPH 1

Dynamics of oxydative property of Str.faecalis with different substrates.
1) glucose; 2) lactic acid; 3) asc.acid; 4) model soln.