POSIBILITIES OF USING PROBIOTIC BACTERIA IN THE PRODUCTION OF DRY FERMENTED LOINS

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Abstract— **In recent years much attention has been paid to the beneficial influence of probiotics for human health. Probiotic bacteria have not applied been in the meat products until now. The aim of this work was to examine the growth and survival of the probiotic strain *Lactobacillus casei* ŁOCK 0900 in dry fermented meats products. It examined their influence on the physical, chemical and sensory quality. The scope and methods of the study included preparation of the inoculum of the probiotic strain *Lactobacillus casei* ŁOCK 0900, microbiological, physical and chemical analysis. Results of the experiment showed that *L. casei* ŁOCK 0900 strain had a good ability to survive in dry fermented pork loins and it can be used for dry fermented loins production.**

***Index Terms*— dry fermented loins, probiotics.**

I. INTRODUCTION

Bacteria of milk fermentation (LAB) are traditionally used in the production of fermented milk products, vegetable silage, bread, meat products, fish, cereals and oriental food. They are used due to their positive effect on sensory properties as well as the fact they inhibit the process of food decay, which constitutes the natural factor extending the durability of food products. In recent years, intensive development has taken place in the research on the production technology of new products of fermented food, both of animal and plant origin, which contain lactic acid bacteria with probiotic properties.

A new idea and solution of using probiotic bacteria are dry fermented meat products. Dry fermented meats are characterized by specific sensory properties that are highly desired by consumers. A characteristic taste and flavour of fermenting meat products appears during the properly performed fermentation and smoking (Kenneally, Leuschner, Arendt, 1998). So far, attempts have been made to introduce the microorganisms under discussion mainly into sausages, which are produced through fermentation, without the high temperature processing.

The purpose of the present studies was to assess the possibility of probiotic bacteria *Lactobacillus casei* ŁOCK 0900 growing and surviving in dry fermented loins and their effect on the sensory and physical-chemical quality of the examined products.

II. MATERIALS AND METHODS

In the production of dry meats the following were used: pork loins, a strain of probiotic bacteria *Lactobacillus casei* ŁOCK 0900, glucose and green tea extract. Three experimental samples were produced: P0 – product without any additives (control), P1 – product with an addition of glucose and a bacteria strain *L. casei* ŁOCK 0900, P2 – product with an addition of glucose, a bacteria strain *L. casei* ŁOCK 0900 and green tea extract. The strain of probiotic bacteria was from the collection of the Institute of Fermentation Technology and Microbiology of the Technical University of Łódź. The process of preparing the initial culture of the probiotic strain consisted in activating the frozen bacteria, and next inoculating them to the raw samples of pork loins. On the other hand, the extract was prepared from the leaves of green tea ”Formosa Lung Ching”.

The loins chilled to 7^{o}C were divided into parts after 48 hours, and next they were cured by means of the ”dry” method using the curing mixture in the quantity of 2.5%. After curing, the strain *L. casei* ŁOCK 0900 (2cm^3/kg of meat, containing 1cm^3 10^9 cfu of probiotic bacteria) and green tea extract (15 cm^3/kg meat) were added to the samples of loins. The latter ripened for three weeks in the growth chamber at the temperature of 16-18°C. They were subjected to smoking with cold smoke once. After the ripening process, the samples were vacuum packed and stored at chilling temperature (4^{o}C) for the period of 6 months. After ripening and storing, the loin samples were assessed as regards the microbiological, sensory and physical-chemical quality.

Microbiological analyses the bacteria of lactic acid were carried out using the automatic system measuring the number of microorganisms - TEMPO® (Biomerieux, France). Original tests TEMPO® LAB, which served to determine the number of bacteria of lactic acid in food products were used for microbiological marking. Results of studies are given in colony forming units in one gram of product (cfu/g). The applied system of microbiological marking made it possible to achieve the level of reliability similar to standards NF ISO 15214 (1998) and recommendations of the Compendium for Microbiological Food Research of American Health Association (2004).

Sensory analyses were conducted using the Quantitative Descriptive Method – QDA (ISO 13299.2, 1998). Four types of markings were performed within physical-chemical tests. Active acidity was measured using a digital pH-meter (Elmetron) and a combined electrode ERH-111 in the water extract of the product (PN-ISO 2917, 2001). The oxidation-reduction potential (ORP) was marked on the basis of the method by Nam and Ahn (2003) using a combined electrode of ERPt-13 type with a digital measurer CPC-501 (Elmetron). The obtained result of the measurement was coverted into the value of the redox potential towards the standar hydrogen electrode E_H, w mV. The index of far oxidation TBARS was measured by means of the absorbance value of the solutioon of the meat product with 2- thiobarbituric acid (Pikul, 1993). The value of TBARS index was expressed in mg of malone aldehyde in 1 kg of the meat product. Next, the colour parameters were measured using the reflection method with colorimeter X-Rite 8200 with a measurement opening with the diameter of 25.4 mm, establishing the value of tri-chromatic coordinates of the system CIE L*a*b*, where L*means the colour lightness, +a* - red component, +b* - yellow component . On the basis of component L*a*b* , the total colour change was calculated according to the equation : $\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{0,5}$.

Results of microbiological, sensory and physical-chemical tests are presented in mean values ($\bar{x}$) and standard deviation (SD).

III. RESULTS AND DISCUSSION

After the ripening process of meat, the number of lactic acid bacteria in control samples, without any additions, was at the level of 10^5 log cfu/g. The obtained results show the number of lactic acid bacteria in the examined meat without an addition of probiotic strains. On the other hand, the number of LAB bacteria in loin samples with an addition of the probiotic strain with 0.2% glucose and in the samples with an addition of strain *L. casei* ŁOCK 0900 and green tea extract was at the level of 10^7 log cfu/g. The number of LAB bacteria stayed at the same level in the samples with an addition of the probiotic strain, hence the conclusion that green tea extract did not have a significant influence on the growth of probiotic bacteria. Comparing the above results of studies, it can be stated that the use of probiotic bacteria in dry fermented meat products makes fermentation possible. The studies by Klingberg et al. (2005) also showed that there was a possibility of growth of probiotic bacteria in meat environment (Fig.1). According to literature, an addition of monosaccharide should range from 0.4 to 0.8% (Libudzisz & Kowal, 2000). In the present studies, the amount of the added glucose was only 0.2% per 1 kg of meat. It can be supposed that a higher addition of glucose to the examined samples of dry fermented pork loins could cause an even better growth of probiotic strains in the examined pork loins.

After 6-months' storage, the studies observed a decrease of the number of LAB bacteria in relation to the samples examined directly after 3-weeks' ripening, in all kinds of studied loin samples, on average by one logarithmic row (Fig.1).

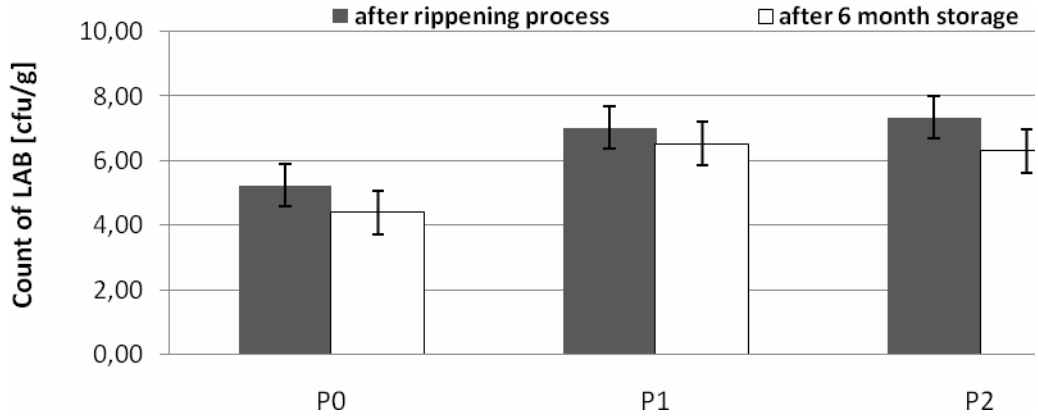

Figure 1. Microbiology evaluation of the fermented pork loins produced with: probiotic culture *Lactobacillus casei* ŁOCK 0900 and glucose (P1), *L. casei* ŁOCK 0900 with glucose and extract of green tea (P2), the controls (P0) after ripening and after 6 month storage

It can be stated on the basis of sensory analysis conducted directly after the meat ripening process that the highest intensity of flavour and taste of the smoked and dried meat was characteristic of the control sample, without any additions. The control also stood out in respect of total quality. Loin samples with an addition of the probiotic strain and 0.2% of glucose on the one hand and on the with the strain, glucose and green tea extract were characterized by similar intensity of the examined sensory markers. It was only loins with an addition of probiotic bacteria and glucose that were

distinguished in respect of the assessment of such markers as other flavours, uniformity of colours and taste of dried meat. The enumerated markers were characterized by the lowest marks, which means they had a smaller influence on the sensory quality of the tested product (Fig.2). Comparing the intensity of feeling the examined sensory properties of dry fermented loins it can be stated that the addition of probiotic strain *L. casei* ŁOCK 0900, glucose or glucose and green tea extract did not have any significant effect on the sensory quality of the product, while significantly improving the growth and survival of probiotic bacteria.

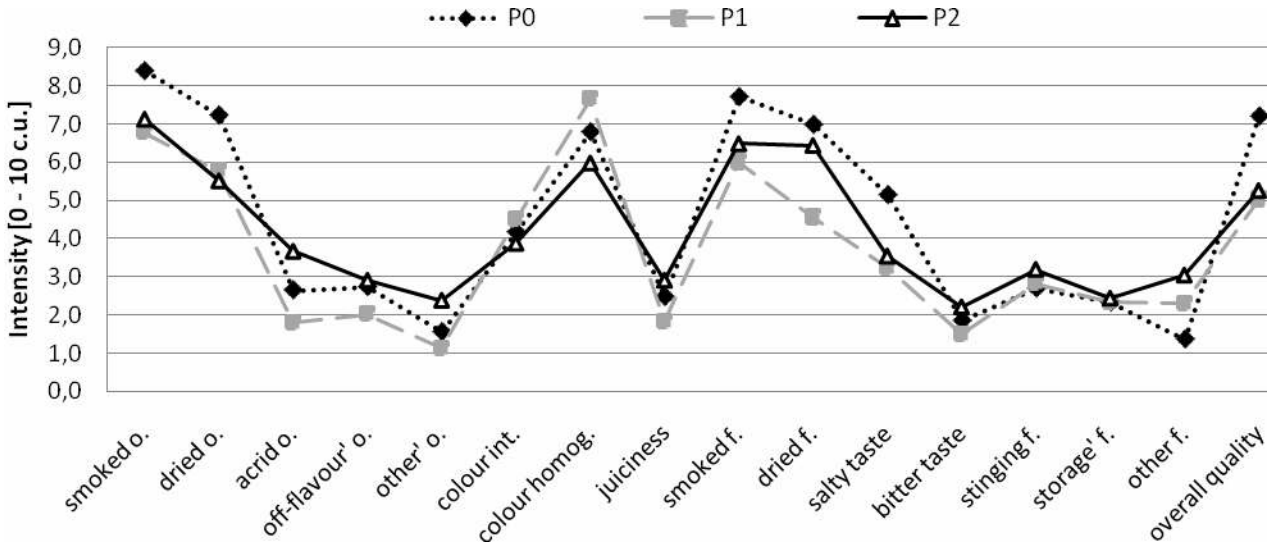

Fig. 2. Sensory evaluation of the fermented pork loins produced with probiotic culture *Lactobacillus casei* ŁOCK 0900 and glucose (P1), *L. casei* ŁOCK 0900 with glucose and extract of green tea (P2), the control (P0) after ripening process; **o.**- odour, **int.**- intensity, **f.**- flavour

Physical-chemical tests (table 1)showed that a product with an addition of probiotic bacteria and glucose was characterized by the highest acidity as compared to the other samples, both after production and in cool storage. The use of strain *L. casei* ŁOCK 0900 and green tea extract in the production of dry fermented loins caused a decrease of the value of redox potential as compared to the value of the control sample after ripening and cool storage. The lowest value of ORP potential (306,6mV) and att he same time the lowest value of TBARS index (0,509 mg of malone aldehyde/kg of product) after storage was found for the product with an addition of *L. casei* ŁOCK 0900 with glucose. The studies found out that an increase of the values of parameters L* (52,67) i a* (7,69) of colour in the sample with an addition of probiotic bacteria and glucose (P1) after storage as compared to the control sample, whereas the highest proportion of yellow colour (7.96) after storage was observed in the control. The studies found no effect of strain *L. casei* ŁOCK 0900 used in the production on the durability of colour. The biggest change of parameter ΔE* of colour after 6-months' cool storage was shown by the sample with an addition of *L. casei* ŁOCK 0900, glucose and green tea extract (5.99).

Tab.1. Assessment of physical-chemical quality of dry fermented loins

Markers	Samples of loin					
	P0		P1		P2	
	A*	B**	A*	B**	A*	B**
pH value						
$\bar{x}$	5,53	5,27	5,41	5,04	5,61	5,26
SD	0,05	0,02	0,18	0,03	0,01	0,02
ORP [mV]						
$\bar{x}$	331,4	353,8	324,9	306,6	317,8	331,6
SD	20,88	2,04	1,23	19,73	0,90	1,87
TBARS [mg malone aldehyde /kg product]						
$\bar{x}$	0,37	0,71	1,04	0,51	0,98	0,89
SD	0,00	0,01	0,01	0,02	0,01	0,02

Parameter L*of colour						
$\bar{x}$	50,11	46,08	48,34	52,67	51,89	46,40
SD	1,64	2,34	2,80	1,31	2,37	3,59
Parameter a* of colour						
$\bar{x}$	5,60	5,83	4,64	7,69	4,24	5,55
SD	2,19	0,75	0,38	0,51	0,03	0,84
Parameter b* of colour						
$\bar{x}$	7,12	7,96	5,42	7,80	7,26	5,25
SD	0,64	1,06	0,91	0,56	1,02	0,97
Total change of colour ΔE*						
$\bar{x}$	4,12		5,81		5,99	

Explanatory notes:
*A – Samples after three weeks ripening process
**B – Samples after 6 months storage time

IV. CONCLUSION

It can be concluded on the basis of introductory studies that the probiotic strain *L. casei* ŁOCK 0900 can be used in the production of dry fermented loins with good sensory, physical-chemical quality and the number of bacteria guaranteeing the probiotic character of the product.

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