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Preservation of Meat Products with a Lactic Acid Bacteria Culture - FloraCarn L-2

M Sc Food Science Lone Andersen, Chr. Hansen, Bøge allé 10-12, Denmark

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Introduction

For decades various methods of fermentation have been tried in order to, by trial and error, counteract undesired spoilage of foods. Lactic acid bacteria (LAB) have been used in food processsing partly due to their technological properties and partly due to their biopreservative properties. During fermentation LAB will produce lactic acid which results in lowering of pH and often additional useful properties are added to the products. The main purpose of the fermentation is not only to preserve products, but also to improve the flavour, colour and texture (Smith and Palumbo, 1981). Fermentation is one way to take advantage of LAB. It is also possible deliberately to apply microorganisms to control the bacteriological status without changing the sensory quality of the products. This is called biopreservation and means that by adding a controlled LAB culture it is possible to inhibit eg pathogenic and spoilage bacteria and thereby obtain a higher degree of product safety and possible improved shelf life.

Among a number of psychrotrophic homofermentative lactobacilli isolated from MA-packed fresh meat, *Lactobacillus alimentarius* BJ-33 was selected and commercialised as a pure freeze-dried culture under the name of FloraCarn L-2. The characteristics of FloraCarn L-2 for biopreservation of MA- and vacuum-packed meat products are as follows: the culture is non-gas producing and capable of growing at 2°C. Hereby the culture is competitive to the psychrotropic flora which normally dominates cold-stored meat products. FloraCarn L-2 ferments glucose and sucrose, but only a small amount of lactic acid is produced. Furthermore, the limited proteolytic and lipolytic activities of FloraCarn L-2 will ensure that the sensory properties of the meat product are not affected. The culture does not produce hydrogen peroxide and production of bacteriocins has not been detected (Jelle, 1991).

Application trials with FloraCarn L-2 comprise a wide variety of meat products, eg whole pieces of fresh meat, different ham products, sliced meat products, fresh and cooked sausages. The products can be divided into two main groups: one consisting of uncooked products and one consisting of cooked products. FloraCarn L-2 can be added directly to the fresh meat together with spices and other ingredients, added to the meat via the curing brine or sprayed onto the surface of uncooked meats. FloraCarn L-2 must be added to cooked products after heat treatment. The meat can be dipped into a solution of FloraCarn L-2 or the competitive flora can be sprayed onto the product as a positive contamination during or after the slicing process or in the package immediately prior to sealing.

Among the above-mentioned trials, the action of FloraCarn L-2 on various pathogenic and spoilage bacteria has been tested. FloraCarn L-2 is able to suppress eg *L. monocytogenes*, *Staph. aureus* (unpublished data), Gram negative flora (Jelle, 1987), control the indigenous LAB (Jelle, 1987, Jelle, 1991, unpublished data), gas producing LAB (Jelle, 1991) and *Brochothrix* (Jelle, 1991). At sensory evaluations by trained panels, it is found that addition of FloraCarn L-2 results in a better sensory quality during shelf life (Jelle, 1991, unpublished data). Furthermore, FloraCarn L-2 prolongs the shelf life (Jelle, 1991).

The present trials were carried out to examine the role of FloraCarn L-2 as a protective culture in bacon.

Materials and methods

Bacon cubes. The experiments were carried out with lightly smoked bacon produced with approx 3.5% salt and with/without 0.5% glucose added to the brine. The bacon was diced into cubes of approx 0.7 x 0.7 cm^2.

Inoculation with FloraCarn L-2. The bacon was inoculated with a water suspension of FloraCarn L-2 giving the bacon approx 10^7 CFU/g. The meats were placed in large plastic bags, sprayed with a controlled amount of bacterial suspension and shaken gently in the bags to disperse the culture properly. The bacon was packed with MA-atmosphere (10% CO_2 and 90% N_2).

Inoculation with *Listeria monocytogenes*. *L. monocytogenes* V80 is a pathogenic strain obtained from the Royal Veterinary & Agricultural University, Copenhagen. The products were inoculated with *L. monocytogenes* in a water suspension applying approx 10^4 CFU/g bacon.

Storage of the samples. The products were stored for up to 9 weeks at 2, 5, 8 and 15°C, respectively.

Microbiological examination. Samples were analysed on the day of production and hereafter the bacon cubes were analysed after three, five, seven, eight and nine weeks of storage. The bacteriological examination was carried out with sample sizes of 45 g, diluted ten times with sterile peptone water and treated for two minutes in a Stomacher. LAB were detected on MRS (Oxoid) anaerobically incubated for three days at 30°C. The cell count was done by pour plating whereas the evaluation of the LAB was carried out by spread plating. The composition of the flora was determined by visual recognition of FloraCarn L-2 and in addition with microscopic examination of colonies with different morphologies. If colonies of FloraCarn L-2 constituted more than 75% of the total amount of colonies, FloraCarn L-2 was said to dominate the flora. *L. monocytogenes* were detected on Palcam (Oxoid) anaerobically incubated for two days at 37°C.

Results and discussion

In the MA-packed bacon cubes, the level of indigenous LAB reaches $>10^7$ CFU/g within three weeks regardless of storage temperature and sugar addition (fig 1). Except for the development of *L. monocytogenes*, the results are the same in the bacon with and without sugar at the temperatures tested. Therefore, only the ones with sugar stored at 2°C and 15°C are illustrated. In all products with FloraCarn L-2 added, the microscopical examination revealed that the culture is dominating all through storage. The

results show that FloraCarn L-2 is able to control the indigenous LAB flora. Hereby, the number of eg heterofermentative gas producing LAB is suppressed resulting in an overall quality improvement of the products.

Addition of sugar to the bacon influences the development of *L. monocytogenes*. It is chosen to illustrate the difference in development of *L. monocytogenes* depending on sugar and FloraCarn L-2 at 2°C (fig 2) and 15°C (fig 3). At all temperatures tested, *L. monocytogenes* is favoured by the sugar added, but still FloraCarn L-2 is able to suppress *L. monocytogenes* to the same extent (fig 4). In the examinations, the contamination level of *L. monocytogenes* is relatively high compared to the number of *L. monocytogenes* normally detected in this type of products (Schmidt & Leistner, 1993). However, the level of 10^3-10^4CFU/g was chosen in order to be able to determine the actual number of *L. monocytogenes*. The detection limit of *L. monocytogenes* is 10^2 CFU/g.

The microbiological examinations confirm that FloraCarn L-2 is able to suppress the indigenous LAB and *L. monocytogenes* in MA-packed meat products. FloraCarn L-2 is proved to be useful as a protective culture not only during cold storage but also in case of temperature abuse as its controlling property is demonstrated at temperatures up to 15°C. The inhibition of pathogenic and spoilage bacteria is of the utmost importance if the cold chain is broken.

Conclusion

Application of a protective culture to cooked and uncooked meat products should be considered to be an additional safety factor. In combination with good manufacturing practice including proper storage and distribution, the culture increases the microbiological safety of food (Holzapfel et al, 1995). In this connection, it has been established that FloraCarn L-2 improves product safety and quality. Application of FloraCarn L-2 to eg bacon cubes ensures that the microflora is dominated by harmless bacteria capable of inhibiting undesirable microorganisms such as spoilage bacteria and *L. monocytogenes*. Furthermore, as the influence of FloraCarn L-2 on pH and sensory properties is negligible, the overall quality of the products is improved during storage because the bacteria responsible for eg producing slime and off-flavour are inhibited by FloraCarn L-2.

References

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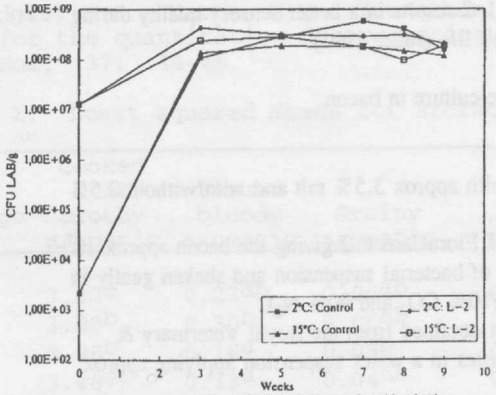
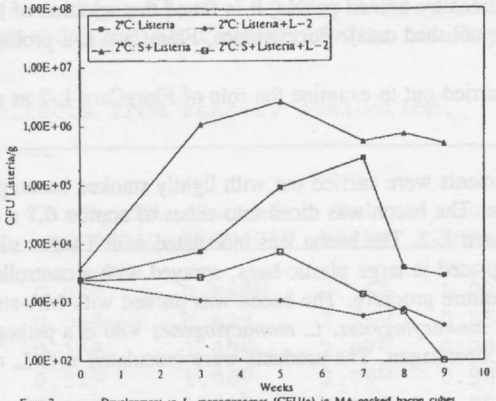
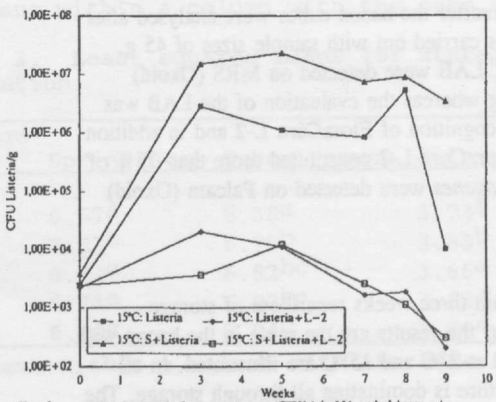


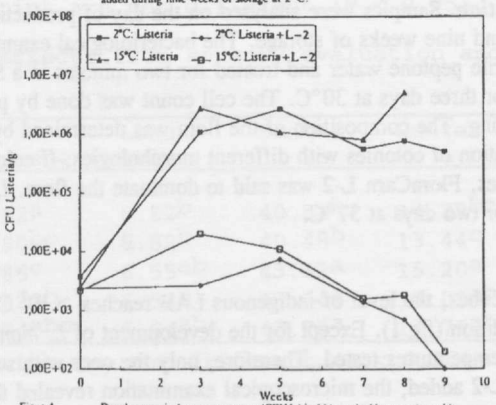
Figur 1. Development in LAB (CFU/g) in MA-packed bacon cubes with and without FloraCarn L-2 added during nine weeks of storage at 2°C or 15°C.



Figur 2. Development in *L. monocytogenes* (CFU/g) in MA-packed bacon cubes produced with and without 0.5% sugar with and without FloraCarn L-2 added during nine weeks of storage at 2°C.



Figur 3. Development in *L. monocytogenes* (CFU/g) in MA-packed bacon cubes produced with and without 0.5% sugar with and without FloraCarn L-2 added during nine weeks of storage at 15°C.



Figur 4. Development in *L. monocytogenes* (CFU/g) in MA-packed bacon cubes with and without FloraCarn L-2 added during nine weeks of storage at 2°C or 15°C