Evolution of microbiota in meat and plant-based burgers during vacuum package storage

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Objectives: Meat is one of the main sources of high biological value protein in the human diet, but the world's population increase is leading to an ever growing demand, which is not sustainable. Therefore, there is a growing interest from both producers and consumers in the so-called meat analogues, to shift toward a reduced meat diet. Among those, plant-based burgers are increasingly being adopted by consumers as a substitute for meat burgers [1,2]. The objective of this study was to compare the behavior during storage of plant-based and meat burgers to determine their shelf life and food safety.

Materials and Methods: A total of seven different types of burgers were evaluated: 1 meat burger (MT), 2 commercials (CB, CE) and 4 not commercial (P1 to P4) plant-based burgers, all based on pea protein. All burgers, immediately after preparation, were in- dividually vacuum packed, stored in the dark at refrigeration temperature (0-4°C). Samples were evaluated on day-0, day-14, and day-28. At each time of sampling, three burgers of each type were analyzed. Various microbiological parameters (total mesophilic aerobic flora, *Lactobacillus* spp., *Lactococcus* spp., enterococci, *Staphylococcus* spp., *Enterobacteriaceae*, total coliforms and *Pseudomonas* spp.) were evaluated according to standard methods [3]. The number of colonies was converted to log of colony forming units per gram (log CFU/g). Sensitivity for spread plate was 102 CFU/g and for pour plate was 10 CFU/g and the 95% confidence limit was set between ±37% and ±12% (i.e., plates with a number of CFU ranging from 30 to 300). Plates with less than 30 CFU were not used for data analysis. pH and water activity (a_w) were also measured at each time of analysis. All data were analyzed with SAS software (version 9.4; SAS Institute Inc., Cary, NC).

Results and Discussion: MT showed lower pH values throughout the entire experiment (time 0 to 28d) while CB and CE had the highest values. The mean pH value decreased during storage in all burgers. As for a_w, CB had the highest value at T0 and T28 and the second highest at T14 while CE had the lowest. The CB, CE and P1 showed a very low bacterial load at the beginning of the experiment. While commercial burger CE and the P1 maintained this trend during the entire experiment, the bacterial load of CB raised and reached values similar to MT, P2, P3 and P4 at the end of storage. The total mesophilic aerobic count was about 10^3 CFU/g at the beginning of the experiment in all burgers and reached about 10^8 CFU/g in MT, CB, P2, P3 and P4 while remained at 10^4 CFU/g in CE and P1. As for spoilage bacterial populations (*Enterobacteriaceae*, total coliforms and *Pseudomonas* spp.), CE and P1 showed the lowest mean values while the other types of burgers (CB, P2, P3 and P4) showed results comparable to meat burgers. *Staphylococcus aureus* was never isolated throughout the entire experiment.

Conclusions: The research and development in the field of meat analogues based on vegetable proteins focuses on the production of sustainable products that recreate conventional meat in its nutritional and physical aspects (texture, appearance, taste, etc.) [4]. At the same time, innovative alternatives must maintain the same level of hygiene and safety for the consumer as the traditional products. Results obtained in this study demonstrate that plant-based burgers can have the same shelf-life as classic burgers or in some cases even a longer one. These data are of considerable importance for producers who intend to develop and invest in this sector.

References:

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Key words: Meat burgers, Plant-based burgers, Microbiota, Shelf life