

Evaluation of exposure to *Listeria monocytogenes* and risk characterization of Listeriosis from the consumption of Semi-hard and Colonia artisanal cheeses in Uruguay

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Listeriosis is a foodborne disease (FBD) of great economic and social impact, caused by the consumption of food contaminated by *Listeria monocytogenes*. In the general population, this pathogen produces mild intestinal manifestations, but in the immunosuppressed population (elderly adults, pregnant women, children under 5 years of age, and individuals with debilitating diseases or with immunosuppressive treatment), it can cause invasive infections with a high fatality rate (16-33%). Listeriosis outbreaks have been linked to various foods, including cheeses and particularly those made with raw milk. Consumption in Uruguay of artisanal cheeses is estimated at 4.3 kg/capita/year. The effect of its physicochemical parameters (pH,  $a_w$ ) on the growth of *Listeria monocytogenes* and the impact that the consumption of artisanal cheese has on public health, are unknown.

In this study, Semi-hard and Colonia cheeses from 6 different farms were analyzed during their ripening, 18 Semi-hard cheeses were ripened at  $10 \pm 1^\circ\text{C}$  until their corresponding sampling. Likewise, 15 Colonia cheeses were ripened at  $10 \pm 1^\circ\text{C}$  for 15 days, at  $20 \pm 1^\circ\text{C}$  for 11 days and then, at  $10 \pm 1^\circ\text{C}$  until analysis. pH,  $a_w$ , moisture, sodium chloride, fat, *Listeria* spp. and *L. monocytogenes* were analyzed in 1 wheel at each time of each type of cheese and farms at 0, 15, 30, 45 and 60 days and also for Semi-hard at 75 and 90 days. The results of pH and  $a_w$ , together with the following variables: count and prevalence of *Listeria monocytogenes* in the two cheeses, size of portion consumed, rate of growth/decrease of the pathogen in both cheeses, types of population (pregnant, vulnerable population and general) and dose-response models to listeriosis, were characterized by probability distributions. With them, the probabilistic model of exposure to *Listeria monocytogenes* due to the consumption of artisanal cheese was built using the @Risk software. The results were estimated using Monte Carlo simulation with 50,000 iterations. The average pH for the Semi-hard was  $5.15 \pm 0.18$  and the  $a_w$   $0.93 \pm 0.01$ . For Colonia, the average pH was  $5.41 \pm 0.14$  and the  $a_w$   $0.96 \pm 0.01$ . For the consumption of each one and assuming an average of 30 g for all populations, the model estimated that the Semi-hard, contained at the time of consumption, 155 colony forming units (CFU) of *Listeria monocytogenes* and the Colonia, 475 CFU. The probabilities of becoming ill were  $3.1 \times 10^{-10}$  and  $9.5 \times 10^{-10}$  in pregnant women,  $2.3 \times 10^{-11}$  and  $6.9 \times 10^{-11}$  in the vulnerable population, and in the general population  $1.2 \times 10^{-12}$  and  $3.7 \times 10^{-12}$  of Semi-hard and Colonia, respectively. Listeriosis cases per year were  $2.5 \times 10^{-6}$  for pregnant women,  $2.4 \times 10^{-6}$  for vulnerable

population and  $7.8 \times 10^{-7}$  for the general population for Semi-hard, and for Colonia the values were 36-37 times higher.

The exposure assessment to *Listeria monocytogenes* due to the consumption of Semi-hard and Colonia artisanal cheeses under the established conditions and using the data collected in this work, suggests that the probability of acquiring listeriosis is extremely rare in all population groups.

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