

## **Wisconsin Should Adopt *Lactococcus lactis* as the State Microbe**

### **Executive Summary**

The State of Wisconsin has designated a number of symbols that are important to the state's identity and heritage: the state animal is the badger, the state beverage is milk, the state pastry is the kringle, and the state dance is the polka.<sup>1</sup> Absent from this list is a state microbe. Since 2013, several states have designated bacteria, fungi, and yeast species that play crucial roles in their state economy, history, and culture, as their state microbes. **Wisconsin should adopt the bacteria *Lactococcus lactis* as its state microbe.** This bacteria is integral to cheesemaking in Wisconsin and to other state food and agricultural industries. This legislation will also provide a unique science outreach opportunity to educate the public about the vital role of microbes in the Wisconsin economy and dairy industry.

### ***Lactococcus lactis* Background**

*Lactococcus lactis*, or *L. lactis*, is a bacterium that is best known for fermenting foods, particularly some cheeses, including Cheddar, Colby, Camembert, Roquefort, Brie, blue, cottage, and cream cheese. Different types, or strains, of *L. lactis* are chosen to build the recognizable flavor profiles of these cheeses.<sup>2, 3</sup> Cheesemakers add *L. lactis* bacteria to milk to convert lactose, the sugar found in milk, into lactic acid. This lactic acid causes milk to coagulate and form curds. *L. lactis* is also used to produce other fermented dairy products in Wisconsin such as buttermilk, cultured butter, sour cream, and kefir. Additionally, lactic acid from *L. lactis* is essential in vegetable pickling and sauerkraut production.<sup>4</sup>

Beyond adding flavor, *L. lactis* is commonly used for maintaining food safety. *L. lactis* produces nisin, a natural antimicrobial that protects against foodborne pathogens, including *Staphylococcus*, *Listeria*, and *Clostridium*. Nisin preserves a wide range of food and beverages, including cheeses, beer, wine, canned foods, pasteurized dairy products, high-acid foods such as salad dressings.<sup>5</sup>

### **History and Impact of *Lactococcus lactis* in the Wisconsin Economy**

The dairy industry, specifically the production of cheese, is central to the Wisconsin economy. Cheesemaking in the state dates back to the mid 1800s, with one of the earliest documented cheesemakers being Charles Rockwell, who produced cheese in the Fort Atkinson area in 1837. Cheese manufacturing improved throughout the 1840s and 1850s, although most cheese was made on individual farms due to low demand for the product. Demand for dairy

---

<sup>1</sup> 2021-2022 Wisconsin Blue Book: [140 State Symbols](#).

<sup>2</sup> Rasovic, M. B.; Mayrhofer, S.; Martinovic, A.; Dürr, K.; and Domig, K. J. (2017). [Lactococci of Local Origins as Potential Starter Cultures for Traditional Montenegrin Cheese Production](#).

<sup>3</sup> Song, A. A.; In, L. L. A.; Lim, S. H. E.; and Rahim, R. A. (2017). [A review on \*Lactococcus lactis\*: from food to factory](#).

<sup>4</sup> Todar, K. (2010). Bacteriology at UW-Madison: [Lactococcus lactis Wisconsin's State Microbe](#).

<sup>5</sup> Ibid 5.

products increased in the late 1800s, leading to the rise of factory-manufactured cheese in the state. By the 1920s, over 2800 cheese factories existed in the state, and Wisconsin became the first state to grade its cheese for quality.<sup>6</sup> The role of immigration and the cultural heritage of Wisconsinites has played an important role in the state's cheese production. French immigrants brought Camembert, Brie, and a variety of blue cheeses, and English immigrants brought Cheddar. Wisconsinites went on to develop unique cheeses, including Colby, Cupola, Muenster, Marble Blue-Jack, Colby-Monterey Jack, and BellaVitano cheese.<sup>7, 8</sup>

Cheesemaking continues to play a crucial and significant role in the Wisconsin economy. Wisconsin agriculture is a major economic driver in the state, accounting for 11.8% of the state's employment and contributing \$104.8 billion to the state economy. The dairy industry alone contributes \$45.6 billion to the state economy each year.<sup>9</sup>

Wisconsin is the number one state in cheese production in the country, producing 3.47 billion pounds of cheese in 2021 and accounting for 25% of the country's cheese production.<sup>10</sup> Notably, Wisconsin is also the largest producer of Cheddar cheese, a product of *L. lactis*. In 2020, Wisconsin produced over 7 million pounds of Cheddar alone (Figure 1).<sup>11, 12</sup> In addition to the quantity of cheese produced, Wisconsin also produces a wide variety of cheese. Wisconsin currently has about 1200 licensed cheesemakers who produce over 600 varieties of cheese, nearly double the number of any other state.<sup>13, 14</sup>

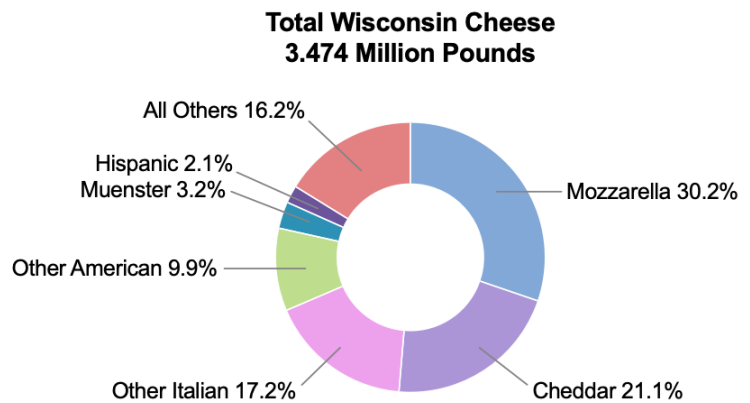


Figure 1. The cheese produced in Wisconsin in 2021. *L. lactis* is involved in the production of Cheddar and Colby (categorized under Other American), as well as other cheeses.

*L. lactis* is involved in many other industries beyond cheesemaking that are important for the state economy. As discussed above, *L. lactis* is involved in the preservation of beer and wine. In Wisconsin, the beer industry accounts for almost 65,000 jobs and contributes \$9.8 billion to the state economy.<sup>15</sup> A 2011 report found that the winery and grape growing industry

<sup>6</sup> Wisconsin's Cultural Resources Study Units, Wisconsin Historical Society: [Cheesemaking in Wisconsin](#).

<sup>7</sup> Ibid 6.

<sup>8</sup> Dairy Farmers of Wisconsin: [6 Wisconsin Original Cheeses You Need to Try](#).

<sup>9</sup> State of Wisconsin DATCP: [Wisconsin Agricultural Statistics](#).

<sup>10</sup> Ibid 9.

<sup>11</sup> USDA NASS: [2021 Wisconsin Agricultural Statistics](#).

<sup>12</sup> Dairy Farmers of Wisconsin: [Cheese Statistics](#).

<sup>13</sup> Ibid 9.

<sup>14</sup> Ibid 12.

<sup>15</sup> Beer Institute and National Beer Wholesalers Association: [Beer Serves America Economic Impact of the Beer Industry](#).

created about \$120 million in economic impact in the state, a large portion of which was due to wine tourism.<sup>16, 17</sup>

Overall, *L. lactis* is involved with a wide variety of sectors in the Wisconsin economy. It plays a crucial role in the agriculture industry, particularly in dairy production, but is also an integral component of state tourism, as well as the historical and cultural identity of the state.

### **State Microbe Successes in other States**

In 2009, legislation designating *L. lactis* as the Wisconsin state microbe passed the Assembly, but was not taken up by the Senate.<sup>18</sup> Since this initial effort, several other states have successfully adopted state microbes.

In 2013, Oregon became the first state to designate a state microbe: *Saccharomyces cerevisiae*, or brewer's yeast, which is involved in the production of alcoholic beverages such as beer, wine, and mead. This yeast has a clear connection to the Oregon economy, as the craft brewing industry brings in billions of dollars to the state every year.<sup>19, 20</sup> In 2019, New Jersey approved *Streptomyces griseus* as its official state microbe. This soil bacteria, discovered in New Jersey in 1943, produces the antibiotic streptomycin that is used to treat several diseases, including tuberculosis.<sup>21, 22</sup> In 2021, Illinois designated the mold *Penicillium rubens* as its state microbe. This mold, first grown in a lab in Peoria, Illinois, produces very high amounts of penicillin, the world's first broad spectrum antibiotic effective against numerous pathogenic bacteria.<sup>23, 24</sup> Hawaii has proposed a state microbe on several separate occasions, *Flavobacterium akiainvivens* in 2013 and 2017 and *Aliivibrio fischeri* in 2014, although neither has yet been passed.<sup>25, 26</sup>

In these states with official state microbes, the legislation has provided unique opportunities for science education, outreach, and communication with the general public. These legislative efforts gained a wide amount of media attention, including news publications at

---

<sup>16</sup> Tuck, B. and Gartner, W. (2014). [Vineyards and Wineries in Wisconsin: A Status and Economic Contribution Report.](#)

<sup>17</sup> Murray, P. (2019). Wisconsin Public Radio: [Wisconsin Wineries Becoming a Major Player in State's Economy.](#)

<sup>18</sup> National Public Radio (2010). All Things Considered: [No State Microbe for Wisconsin.](#)

<sup>19</sup> Oregon Live: [House Concurrent Resolution 12.](#)

<sup>20</sup> Beer Institute and National Beer Wholesalers Association: [Beer Serves America Economic Impact of the Beer Industry.](#)

<sup>21</sup> Bates, T. B. (2018). Rutgers Today: [Rutgers Discovery That Changed the World May Become New Jersey's State Microbe.](#)

<sup>22</sup> National Public Radio (2018). All Things Considered: [N.J. Legislature Close to Giving Garden State an Official Microbe with Local Roots.](#)

<sup>23</sup> USDA Agricultural Research Service: [Penicillium Strain Named State Microbe of Illinois.](#)

<sup>24</sup> Wetli, P. (2021). [WTTW News: Illinois Now Has an Official State Microbe. Why?](#)

<sup>25</sup> Hawai'i State Legislature [SB1212.](#)

<sup>26</sup> Hawai'i State Legislature [HB1217.](#)

the local and national levels, scientific journals, radio and podcast shows, and TV programs.<sup>27, 28, 29, 30, 31</sup> One notable example of science outreach came from the New Jersey state microbe initiative. Following the approval of *Streptomyces griseus* as the state microbe, the Liberty Science Center museum opened an exhibit titled “Microbes Rule!” This exhibit features interactive learning stations and art, highlighting the beneficial and essential role microbes, particularly the new state microbe, play in our society.<sup>32, 33</sup>

Furthermore, adoption of a state microbe allows the scientific community to engage with the legislative process. Information about the history, science, and political process of creating a state microbe has been presented at several conferences and universities and has involved scientists across the country in the process of proposing legislation.<sup>34, 35</sup>

## Conclusions

*L. lactis* is a bacterium that plays an essential role in Wisconsin’s economy, culture, and state identity, particularly in the cheesemaking process. **Wisconsin should adopt *Lactococcus lactis* as the state microbe.** Such legislation will provide unique opportunities for science education, outreach, and communication with the general public, and would also engage the scientific community with the legislative process. Such legislation would honor the artistry and innovative legacy of the agricultural and dairy leaders across Wisconsin.

---

<sup>27</sup> WQAD8 (2019): [Illinois Lawmakers Could Name Official State Soda. Microbe.](#)

<sup>28</sup> Ibarra, R. (2019). WNYC News: [New Jersey is Close to Having a State Microbe.](#)

<sup>29</sup> Pfaff, L. G. (2019). New Jersey Monthly: [Not Your Average Germ: New Jersey Considers a State Microbe.](#)

<sup>30</sup> National Public Radio (2010). All Things Considered: [No State Microbe for Wisconsin.](#)

<sup>31</sup> CUNY TV: [Meet the NJ Microbe!](#)

<sup>32</sup> Liberty Science Center: [Microbes Rule!](#)

<sup>33</sup> Liberty Science Center (2018): [Joined by friends and advocates, LSC announces support for official state microbe.](#)

<sup>34</sup> Nichols, D. Seton Hall University (2018): [Seton Hall University to Host the Theobald Smith Society Meeting in Miniature.](#)

<sup>35</sup> Warhol, J.; Eveleigh, D.; and Haggblom, M. ASM Microbe (2018): [How to Get Your Own Official State Microbe.](#)