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WEISELLA AND *PERIWEISSELLA* GENUS: ROLE OF *WEISSELLA* FERMENTATION. A REVIEW

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Abstract
Bacteria belonging to the genera *Weisella* and *Periweiseilla* are lactic acid bacteria, mainly by the production of lactic acid from the fermentation of carbohydrates, which emerged in the last decades for their probiotic and biotechnological potential. The genus *Weisella* is composed of bacteria classified as gram-positive, catalase negative, non-spore forming, coccoid morphology or short bacilli. *Weisella* species are distributed in different habitats such as soils, milking machines, sugar cane and some strains with interesting technological features can be isolated from spontaneous fermented foods and participate to the characteristics of the fermented products, such as cheeses made from raw milk, fermented vegetables and fermented milk. The only limitation to its widespread use is the lack of a significant volume of research at the moment and a handful of reported cases of pathogenicity.

Introduction
Fermentation has been applied for thousand years as a method to preserve perishable foods. nowadays, a large variety of fermented foods are consumed around the world and appreciated for their organoleptic and sensory properties, including cheese, yoghurt, sourdough, olives, fufu, pickles or sausages (Kim *et al.,* 2017). Among the microorganisms available as starter cultures, lactic acid bacteria (LAB) are the most diverse. They are used to start wine, bread, vegetable, meat and dairy product fermentation (Fessarrd *et al*., 2017). Among other fermentation processes, lactic acid fermentation is a valuable process which enhances the safety, nutritional and sensory properties of food. The use of starters is recommended compared to spontaneous fermentation, from a safety point of view but also to ensure a better control of product functional and sensory properties (Kim *et al.,* 2017).

Distinction between Weissella and other LAB
The distinction between Weissella and other LAB remains impossible based only on morphological observation since they produce gas from carbohydrates. Identification of *Weissella* spp is performed with molecular methods such as 16S rRNA gene sequencing amplified ribosomal DNA restriction analysis, ribotyping, MALDI-TOF or fluorescent amplified fragment length polymorphism. The genome sequence of 28 strains belonging to 12 species has been published (Genbank). The smallest genome belongs to *Weissella halotolerans* and *W. ceti,* which share the same taxonomic branch. The largest genome belongs to *W. cibaria, W. confusa* and W. oryzae, all these three species having been isolated from fermented foods (Lee *et al.,* 2015).

Occurrence of Weissella in spontaneous fermentation
Numerous weissella strains have been isolated from large panel of spontaneous fermented foods including fruits and vegetables-based foods, fermented meat and fish products and starchy or cereal-based foods. Frequent detection of weissella in spontaneous fermented foods strengthens the fact that they able to adapt to a multitude of environment and paly an important role in fermentation process (Tamang *et al.,* 2016).

Selected strains for fermentation

Weissella species are frequently isolated from spontaneous fermented foods and participate to the characteristics of the fermented product. The suitability of *W. cibaria* and *W. confusa* to be used as starters for bread making was analysed following an integrated approach including phenotypic, genotypic, and metabolomic characteristics. *W. cibaria*-com2 was identified (Lopez *et al.,* 2022) as a strain able to perform an intense proteolysis in wheat flour doughs leading to release huge amounts of numerous amino acids and peptides, some of which belong to the branched-chain amino acid-derived compounds (BCAA). Thus, the differential metabolite profile of that strain was partially explained by a genome investigation for putative differences in peptidases, proteases, and amino acid/peptide transporters (Lopez *et al.,* 2022). In particular, a higher presence of amino acid permeases, peptidases (C40 family), and oligopeptide ABC transporters was found in this strain as compared to other *Weissella* spp. strains (Lopez *et al.,* 2022). Proteolysis is indeed considered as a key process in food fermentation leading toward a higher impact on the technological, nutritional, organoleptic, and functional features of the fermented foods. *W. confusa* SD8 was used for making a sorghum sourdough in the study of Olojede *et al.* (2022) and was found to confer an optimal specific volume to the bread and moreover also contributed to tannin degradation (Olojede *et al.,* 2022). Tannins are very abundant in sorghum flour (such as in other minor cereals, pseudocereals, and legumes) and considered as antinutritional factor since they are able to bind proteins making them refractory to digestion and are responsible for the bitter taste of different plant-based ingredients. Tannins are very abundant in sorghum flour (such as in other minor cereals, pseudocereals, and legumes) and considered as antinutritional factor since they are able to bind proteins making them refractory to digestion and are responsible for the bitter taste of different plant-based ingredients. A *W. koreensis* strain (DB1) isolated from kimchi producing high levels of ornithine was proposed as a functional starter culture for rice bran fermentation (Yeong *et al.,* 2020). Ornithine is produced in microbes from arginine throughout the intracellular arginine deiminase pathway (Yeong *et al.,* 2020). Different *Weissella* strains were also proposed as starters for kimchi production due to their technological characteristics, even though these were also found to exhibit a weak haemolytic activity (Jeong and Lee, 2015). *W. cibaria* M3 was used (as mixed starter, in association with Lactococcus lactis) to produce a typical Chinese fermented fish product (Chouguiyu), showing optimal organoleptic characteristics (Bao *et al.,* 2018). A folate-producing strain of *W. cibaria* (PL17-3) was also selected for the production of fermented fish (Deatraksa *et al*., 2018). Sixteen *Weissella* isolates from artisanal Heavy metal biosorption by weissellas Apart from antimicrobial activity of weissellas, the study of Li *et al*. (2021) also demonstrated the cadmium biosorption of *W. viridescens* ZY-6, isolated from fermented pickles, whereas Kinoshita *et al.* (2016) demonstrated the biosorption properties of W. viridescensMY205 isolated from bovine intestine for the periodicgroup12metalscadmium (Cd), mercury (Hg), and zinc (Zn). Considering the detrimental effects of heavy metal pollution of food and beverages on human and animal health, the role of weissellas as heavy metal absorbents may be of high importance. Weissellas may also play an important role in binding of aflatoxins. Kavitake *et al.* (2020), for example, demonstrated that a strain of *W.confusa*, isolated from an Indian traditional fermented food (Idli batter), produced a galactan exopolysaccharide with aflatoxin B1-binding activity. As in the case of heavy metals discussed ab ove, this may prevent absorption of the aflatoxin in the human body once the food with the bacteria is ingested. However, more research in this would be required. Exopolysaccharides produced by weissellas Among the metabolites produced by weissellas, exopolysaccharides (EPSs) play an important role in several beneficial and technological functions. Since 2015, when Fusco et al. (2015) reviewed the research published on weissellas' EPS up to that date, a plethora of papers were published dealing with the characterization of weissellas producing EPS (Table7). Mainly homo- but also

heteropolysaccharides have been found in W. cibaria and W. confusa strains of various origin, with technological and functional properties. However, in addition to the study of Park et al. (2022), who demonstrated the functional laxative effects of milk fermented with a probiotic

Safety assessment of Weissella and Periweissella

Since 2015, when Fusco et al. (2015) provided an overview of studies published until that year on the probiotic potential of weissellas, many further articles on the same topic have been published up to date. As reported in Tables 5, 6, most of the studies focused on W. confusa and W. cibaria strains isolated from various ecological niches. For the majority of the potentially probiotic strains, a safety assessment consisting of investigations into the antibiotic susceptibility and the hemolytic activity was performed. However, Sturino (2018) carried out a literature-based safety assessment of W. confusa, concluding that many strains of this species can be safely used for poultry in direct fed microbial products. Cupi and Elvig-Jørgensen (2019) assessed the toxicological safety of W. confusa by in vivo, in vitro, and ex vivo studies. In the tested conditions, no toxic effects were shown by W. confusa allowing to conclude that this species could be used as a safe direct-fed microbial product (Cupi and Elvig Jørgensen, 2019). However, for their studies, they used "an off powder of freeze-dried bacteria composed of almost entirely W. confusa," but no specification on the composition in strain/strains of this powder was made. By contrast, Bourdichon et al. (2021) used 46 strains of W. confusa (17 of clinical and 26 of food origin) to provide a safety assessment based on their hemolytic activity and antibiotic susceptibility, as well as on the search of antibiotic resistance genes, virulence determinants, and genes coding for deleterious metabolites (such as biogenic amines) within their genomes. Moreover, a literature search was conducted to find reports of infection caused by strains of *W. confusa* (Bourdichon *et al.,* 2021). This study allowed Bourdichon *et al.* (2021) to consider *W. confusa* as "safe for use in the food chain, food culture for fermentation, or as probiotic strain candidate". Jang *et al.* (2021) performed a safety assessment of W. cibaria JW15 by phenotypic (antibiotic susceptibility, production of toxic metabolites, and hemolytic activity) and genotypic analyses (whole-genome sequencing and search of virulence and antibiotic resistance genes), confirming the safety of this strain.

Conclusion

In the last decades the number of articles published on weissellas has increased enormously. Novel species have been discovered, the taxonomy of the genus has changed so that a new genus, namely Periweissella, has been derived from the previous genus *Weissella,* and new insights into the safety, biotechnological, and probiotic potential of weissellas and periweissellas have been provided. Regarding their technological characteristics, the weissellas and periweissellas have excellent potential with reference to their proteolytic and saccharolytic, as well as antimicrobial and EPS production activities, thus contributing greatly to the safety and functionality of the products. These groups of LAB have a high potential for biotechnological application, and the probiotic potential of numerous strains is being demonstrated. However, for their application in food, a strain-based assessment of their safety still remains mandatory.

REFERENCES

Fanelli, F., Montemurro, M., Chieffi, D., Cho, G.-S., Low, H.-Z., Hille, F., et al. (2023a). Motility in Periweissella species: genomic and phenotypic characterization and update on motility in Lactobacillaceae. Microorganisms 11, 2923.

Fanelli, F., Montemurro, M., Verni, M., Garbetta, A., Bavaro, A. R., Chieffi, D., et al. (2023b). Probiotic potential and safety assessment of type strains of Weissella and Periweissella species. Microbiol. Spectr. 11, e0304722

Fang, R. S., Dong, Y. C., Chen, F., and Chen, Q. H. (2015). Bacterial diversity analysis during the fermentation processing of traditional Chinese yellow rice wine revealedby 16S rDNA 454 pyrosequencing. J. Food Sci. 80, M2265–M2271. doi: 10.1111/1750 3841.13018

Fernández-Niño, M., Rodríguez-Cubillos, M. J., Herrera-Rocha, F., Anzola, J. M., Cepeda Hernández, M. L., Aguirre Mejía, J. L., et al. (2021). Dissecting industrial fermentations of fine flavour cocoa through metagenomic analysis. Sci. Rep. 11, 8638. doi: 10.1038/s41598-021-88048-3

Fessard, A., and Remize, F. (2017). Why are Weissella spp. not used as commercial starter cultures for food fermentation? Fermentation 3, 38. doi: 10.3390/fermentation3030038

Fessard, A., and Remize, F. (2019). Genetic and technological characterization of lactic acid bacteria isolated from tropically grown fruits and vegetables. Int. J. Food Microbiol. 301, 61–72. doi: 10.1016/j.ijfoodmicro.2019.05.003

Fusco, V., Quero, G. M., Cho, G.-.S., Kabisch, J., and Meske, D., Neve, H., et al. (2015). The genus Weissella: taxonomy, ecology and biotechnological potential. Front. Microbiol. 6, 155. doi: 10.3389/fmicb.2015.00155

Kim, D. H., Kang, M. S., Yeu, J. E., Lee, M. G., and Cho, J. W. (2020a). Inhibitory effect of the probiotic bacteria, Weissella cibaria CMU on halitosis: a randomized placebo controlled study. J. Korean Acad. Oral Health 44, 246–252. doi: 10.11149/jkaoh.2020.44.4.246

Lee, J., Lee K. C., Ahn, J., Park, Y. (2015). Weissella koreensis isolated from kimchi. *International journal of syst. Evol microbiol*. 52:1257-1261

Li, J., Ai, L., Xu, F., Hu, X., Yao, Y., Wang, L., et al. (2022). Structural characterization of exopolysaccharides from Weissella cibaria NC516, 11. in distiller grains and its improvement in gluten-free dough. Int. J. Biol. Macromol. 199, 17–23. doi: 10.1016/j.ijbiomac.2021.12.089

Oladejo, B. O., and Oluwasola, J. M. (2022). Hematological modulatory effects of Weissella and Pediococcus sp. on formalin-induced inflammation in wistar rats. Asian J. Biotechnol. 19, 28–34. doi: 10.13057/biotek/c190105

Tamang, J. P., Watanbe, K., Holzapel, W. H. (2016). Diversity of microorganisms in global fermented foods and beverages. *Frontier in microbiology*. 7:377-384