

Degree Course: FOOD SCIENCES AND TECHNOLOGIES

Subject: FERMENTATION MICROBIOLOGY

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AIMS

The module of *Fermentation microbiology* aims to give specific knowledge of (a) fermented food microbiology, focusing the attention on the selection of microbial starters to use in food field and of (b) industrial microbiology and microbial metabolism. Moreover, the students will learn some applicative aspects of the microbiology of fermentations; particular emphasis will be given to the microorganism clonal techniques to obtain strains starter for the fermented food production. Throughout the training in the laboratory, adequate emphasis on the strategies to use in order to operate under optimal safety conditions will be given.

PROGRAM

Introductory lesson: presentation of the contents of the program, the suggested reference text and the evaluation methods adopted. The role of microorganisms in food: sources of microbial contamination; moments of microbial contamination; virtuous, altering and pathogenic microorganisms. Ecophysiology of microorganisms in food. The determination of microorganisms in food: microbial identification. Coagulase negative cocci: general information on taxonomy and general characteristics; ecology; physiology; biotechnological applications. Lactic bacteria: general information on the taxonomy of lactic bacteria applied to food and on the metabolism of lactic bacteria in food. Acetic bacteria: general information on the taxonomy of acetic bacteria and on the products of oxidative metabolism; isolation and cultivation of acetic bacteria; the conservation of acetic bacteria. Spore-forming bacteria: structure of endospores and their resistance; the mechanism of sporulation; germination; general information on "superdormant" spores and risks in the food sector and on the energy metabolism of endospore producers of food interest; spore-forming agents of alterations in food. Enterobacteria: common properties of enterobacteria; general information on taxonomic characteristics and metabolic aspects; enterobacteria and pathogenicity; the role of enterobacteria in food. Yeasts: morphological characteristics; metabolic characteristics; factors affecting yeast development; general information on taxonomy; the role of yeasts in food. The filamentous fungi: introduction; general information on systematic classification; morphological characteristics; metabolism; environmental parameters; reproductive modalities; fungi contaminating food and drink; filamentous fungi in food production. Water and food ice: the potability of water. Microbial starters: evolution of fermented productions and microbial starters; classification of starter cultures microbial biodiversity, selection criteria and improvement approaches. Yogurt and fermented milk-based drinks: general information on the microbiology of yoghurt and fermented milk-based drinks; characteristics of yogurt and the main fermented milk-based drinks. Cheese and butter: cheese; butter. Fermented raw salami: raw material and ingredients; fundamental aspects of the production process; microorganisms involved in the transformation processes; use of starter cultures. Bread and other leavened bakery products: raising agents - brewer's yeast and natural yeast; description of the yeasts and lactic bacteria involved in the fermentation process; physiology and biochemistry of yeasts and lactic bacteria; microbial contamination of leavened bakery products; nutritional aspects. Fermented products of vegetable origin: table olives; sauerkraut. Cocoa and coffee. The wine: the microbiota of the grapes; the microbiota of the cellar; spontaneous fermentation; the main non-Saccharomyces yeasts; guided fermentation; mixed fermentations; lactic bacteria in wine; wine diseases. Beer: raw materials; the brewing process; conventional yeasts in the brewing process; non-conventional yeasts in the brewing process; definition and classifications of the different brewing styles and innovative beers. Vinegar: general information on vinegars - from definitions to types; the fermentation processes; starter cultures for vinegar production - consolidated and emerging aspects; alterations of the vinegar of a microbiological nature. Bioprocesses and ingredients of microbial origin. Concluding lesson: verification of the didactic effectiveness of the lectures cycle and debate on related broad topics; presentation of the laboratory training program. **Laboratory training** (theoretical lessons) - Technique for carrying out a complete sterilization cycle of culture media and differentials: weighing of the ingredients and their solubilization, packaging, sterilization in an autoclave. Technique for the preparation of thermised must with oenological oil in test tubes and small bottles for the evaluation of the fermentative vigor and resistance to sulfur dioxide of newly isolated yeast strains. technique for collection at -80°C using the Protect system of yeast strains. Technique of pure culture isolation of yeast strains by smear plate of YPD agar. Procedures for carrying out the tests to evaluate the fermentative vigor and resistance to sulfur dioxide of yeasts of oenological interest by inoculation in thermised must with or without the addition of sulfur dioxide: inoculation and determination of $\Delta 2$ and $\Delta 7$. How to interpret yeast development in BiGGY Agar, GraSki Agar and CaCO₃ Agar plates. **Laboratory training** - Microscopic observation of the following yeasts from food: *Candida pulcherrima*, *Hanseniaspora osmophila*, *Kluyveromyces marxianus*, *Pichia kudriavzevii*, *Saccharomyces cerevisiae*, *Yarrowia lipolytica*, *Zigosaccharomyces bailii*, in order to acquire the ability to recognize their differences. Quality judgement of commercial yogurt samples by microscopic observation and evaluation of the ratio cocci/bacilli, length of the chains, presence/absence of eukaryotic cells.

TEXT ADOPTED

Cocolin L., Gobbetti M., Neviani E. - Microbiologia alimentare applicata. Prima edizione. Casa Editrice Ambrosiana (MI), 2022.

JUDGMENT

Oral examination in Italian or English language.