Paper No.: 03

Paper Title: FOOD MICROBIOLOGY

Module – 18: Microbiology of cereal and dough products

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INTRODUCTION

- Cereals are a rich source of vitamins, minerals, carbohydrates, fats, oils, and protein.
- Some common cereals are: corn (maize), wheat, barley, rice, oats, rye etc.
- Cereal products derived from cereal grains such as wheat, rye, and oat flours and semolina, cornmeal, corn grits, doughs, breads, breakfast cereals, pasta, snack foods, dry mixes, cakes, pastries, and tortillas.

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQ6gdQXbwe_VwNqtlTYsQclKA0UOieXw24Sg7jPi4Qc2nsTx6zlbg

DOUGH

- Dough is a thick, malleable, sometimes elastic, paste made out of any cereals (grains) or leguminous crops.
- It is prepared by mixing flour with a small amount of water and/or other liquid and occasionally includes yeast or other leavening agents as well as other ingredients like various fats or flavourings.

http://upload.wikimedia.org/wikipedia/commons/7/74/Cinnamon_rolls_-_dough_ready_to_roll.jpg

MICROBIOLOGY OF CEREALS AND DOUGH PRODUCTS

- The microbiology and safety aspects of cereals and dough products is measured very carefully due their wide use as food and feed resources.
- The sources of microbial contamination of cereals and dough products are numerous such as air, dust, soil, water, insects, rodents, birds, animals, humans, storage and shipping containers and handling and processing utensil or equipment.
- The microflora of cereals and cereal products is diverse and includes molds, yeasts and Bacteria.

http://upload.wikimedia.org/wikipedia/commons/f/ff/Hordeum_vulgare_Clavic eps_purpurea_23-7-2009.JPG

WATER ACTIVITY OF SOME FOODS OF PLANT ORIGIN

Table 2.1: Water activity of some foods of plant origin

Foods	Water activity
Fruit and vegetables	0.97- 0.98
Bread	0.96-0.97
Fruit Jam	0.82 - 0.94
Flour, rice, bean and peas	0.80 - 0.87
Stewed fruits	0.60 - 0.65
Pastes, spices	0.20 - 0.60

Source: www2.univet.hu/sc1/feltoltott/428_1306839856.doc

MINIMUM WATER ACTIVITY REQUIREMENTS OF MICROORGANISMS

Table 2.2: Minimum water activity requirements of microorganisms

Group of microorganism		Minimum a_w
Bacteria	Most Gram-negative	0.97
	Most Gram-positive	0.90
	Halophilic	0.75
Yeasts	Most yeasts	0.88
	Osmophilic	0.62
Fungi	Most filamentous	0.80
	Xerotolerant	0.71
	Xerophilic	0.61

Source: www2.univet.hu/sc1/feltoltott/428_1306839856.doc

MINIMUM WATER ACTIVITY REQUIREMENTS OF SOME IMPORTANT SPOILAGE FUNGI

Table 2.3: Minimum water activity requirements of important spoilage causing fungi

Group	Species	Minimum a_w
Field fungi	*Fusarium culmorum*	0.89
	Fusarium graminearum	0.89
	Alternaria alternate	0.88
	Cladosporium herbarum	0.88
Storage fungi	*Penicillium aurantiogriseum*	0.82
	Penicillium brevicompactum	0.80
	Aspergillus flavus	0.78
	Aspergillus candidus	0.75
	Eurotium amstelodami	0.71
	Willemia sebi	0.69

Source: www2.univet.hu/sc1/feltoltott/428_1306839856.doc

BACTERIA

- Bacteria are found as most frequent surface contaminants of cereal grains.
- To grow in cereal grains, bacteria need high moisture or water activity (a_w) in equilibrium, with high relative humidity.
- Bacterial pathogens like *Bacillus cereus, Clostridium botulinum, Clostridium perfringens, Escherichia coli and Salmonella and Staphylococcus aureus* may contaminate cereal grains and cereal products and cause spoilage.
- Coliforms and enterococci used as indicators of unhygienic handling and processing conditions and potential fecal contamination.

http://2.bp.blogspot.com/_Lte0Ze_ZYLQ/S58gub3XPsI/AAAAAAAAAAw/4otZJxrDZFI/s400/aspercorn.jpg

FUNGI

- Approximately more than 150 species of filamentous molds and yeasts on cereal grains are present as surface contaminates.
- Yeasts are frequently less in number as compare to molds.
- Most significantly, the filamentous fungi that occur on cereal grains may be divided into two groups on the basis of their predominance in grain in relation to water activity of in the grains:

1. Field fungi

2. Storage fungi

FIELD FUNGI

- Such fungi are well adjusted to the sudden quickly changing conditions on the surfaces of senescing plant material in the field.
- For examples, species of *Alternaria, Cladosporium, Fusarium* and *Helminthosporium*.
- They need relatively high water activities for optimum growth and able to survive the rapid changes.
- These field fungi attack grain in the ground when the grain is high in moisture environment (18 to 30%, i.e., at high $a_{w;}$ Table 2.2) and at high relative humidities (i.e. 90 to 100%).

STORAGE FUNGI AND THE MOISTURE CONTENTS OF COMMODITIES AT WHICH MOLD INVASION MAY OCCUR

Table 2.4: Relationship in between the moisture contents of commodities and storage fungi, at which mold invasion may occur

Marketable food items	Moisture content (%)	Storage fungi
Starchy cereals	16.5 -20.0	*Penicillum* (blue eye in corn)
	17.0-18.0	*Aspergillus flavus*
	15.5-16.0	*A. candidus, A. ochraceus*
	14.5-15.0	*Eurotium glaucus*
	14.0-14.5	*A. restrictus* (blue eye),
Soybeans	17.0-20.0	*Penicillum* (blue eye in corn)
	17.0-17.5	*A. flavus*
	14.5-15.0	*A. candidus, A. ochraceus*
	12.0-12.5	*A. restrictus* (blue eye), *E. glaucus*
Sunflower	10.0-15.0	*Penicillum* (blue eye in corn)
	9.0-9.5	*A. candidus, A. ochraceus*
	8.5-9.0	*A. restrictus* (blue eye)

Source: http://www.foodquality.com/SpringboardWebApp/userfiles/fqu/image/FQU_2011_FebMarch_pp28_t02.jpg; Christnsen and Menonuck (1986).

STORAGE FUNGI

- In general, storage fungi are well adapted to the more constant conditions of cereals in storage and usually grow at lower water activities, lower moisture contents (14 to 16%) and lower relative humidities (65 to 90%) (Table 2.2; 2.3; 2.4).
- For example: *Penicillium aurantiogriseum, Penicillium brevicompactum, Aspergillus flavus, Aspergillus candidus, Eurotium amstelodami, Willemia sebi* etc.
- Water activity and temperature are considered the most important environmental factors inducing the mold spoilage of cereals and the probable production of mycotoxin.

http://foodtesting.eurofins.cn/media/1680774/mycotoxin300_200.jpg

THANK YOU