**Bread staling**

 Bread staling involves organoleptic and physicochemical changes such as firming of crumb, declining flavor, increasing opacity of crumb, toughening of crust, and decreasing starch solubility that occur during aging.

Commercially, "staling" is defined as a term which indicates decreasing consumer acceptance of bakery products caused by changes in crumb other than those resulting from the action of spoilage organisms.

**The key factors that relate to staling that have been studied extensively include:**

 (1) Changes in moisture content: moisture migration within the product and the possible interactions between starch and gluten .

(2) Changes in taste and aroma , increased firmness ,opacity , crumbliness , and crystallization of starch in the crumb .

(3) Decreased absorption capacity of the crumb , decreased susceptibility of the crumb to β-amylase and decrease content of soluble starch.

(4) Softening of the crust and hardening of the crumb are related to redistribution of water with in loaf (crumb to crust migration ) during storage.

**After Baking: Staling Bread**

* As soon as the bread cools down, a process of degradation of its structure starts
* Several bread characteristics will be modified
	1. **The crumb**
	2. **The crust**
	3. **The flavor**

**1- The crumb**

* Crumb degradation mostly due to a migration of water
* During starch gelatinization, the water surrounding the particle of starch will move from the outside of the particle to the inside.
* Temperature at which starch granule begins to absorb water and swell135-165°F (57-74°C) for most cereals ,Granule then becomes permeable
* Continued temperature increases cause more swelling
* Amylose leaches out of starch granule .
* When the bread cools, these chains retract to reorganize into their initial structure
* The crumb will then become more dense and loose its softness
* This process is more active when the bread is kept at temperature around 40ºF

2- **The crust :**

* **Several crust properties will be penalized**
	1. Loss of crispiness
	2. Crust gets tougher and more leathery
	3. Changes from glossy to dull
* **Changes are mainly caused by**
	+ Migration of water from the crumb to the crust
	+ Migration of water from the air to the crust

**3- The flavor :** Aromas are very volatile compounds

* When the bread starts to cool down, some aromas evaporate
	+ Contributes to a pleasant smell in the bakery
* Modification of the structure of the bread affect the flavor of the bread
	+ Less pleasant and less attractive to the customer



 Whatever be the case, stale bread can be temporarily refreshed by heating it to 50–60˚C, resulting in the melting of the amylopectin crystallites.

**Mechanisms to prevent staling have fallen into four general classifications**:

(1) Addition of polymers such as hydroxyl cellulose

(2) Addition of emulsifiers

(3) Addition of enzymes such as α-amylase

 (4) Use of modified starches, chemically or physically modified and genetically modified (e.g. waxy wheat starch )

* Packaging
	+ Paper bags versus plastic bags
* Freezing baked bread can delay the staling .

**Baking process can make a difference ;**

1. Hydration of the dough
* Higher hydration will improve shelf life
1. Fermentation time
* Longer fermentation time is beneficial

3-Avoid excessive volume of the final products

* Limit loss of moisture

4-Appropriate baking time and temperature

* Limit the drying of the crust



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