

**Bacteria responsible for food degradation multiply at pH 7.
pH 4.5 acidic foods are stable, without bacterial growth.
A food can be acidified by adding acid or fermentation.**

Food degradation is mainly caused by **germs**. To conserve food, it is necessary to fight germs, by 3 complementary approaches:

- 1- Avoid contamination,
- 2- Kill germs, and/or
- 3- Inhibit their development

Acidification and changes in the pH of food can kill or limit their development.

Bacteria multiply well towards pH 7. Each bacterium has an optimal pH between 4.5 and 9. Even relatively acid-tolerant pathogens (Staphylococci and Listeria) grow very poorly under pH 4.5.

The lactic acid bacteria are non-pathogenic and have an optimal pH of 5.

Regulations say that acidic foods (pH 4.5) are stable (no bacterial growth).

Moulds (pH 1.5 to 10) and **yeasts** (pH 2 to 9) have optimal pH values lower than bacteria : acidic foods mould easily (like oranges).

What is the pH of food ?

Yogurt : pH 4.5 - Juice and fruit ; pH 4 (3.5 to 4.9)

Lemon : pH 2.3 - Wine : pH 2 - Cola : pH 1.5

Stomach : pH 1

Some foods are very acidic with no bacterial growth possible (but mould grows slowly at pH 4)

Other foods are also relatively acidic and therefore relatively protected, like meat (pH 5.6) - Vegetables (pH 5.2-6.2) less well protected than fruits.

Are all organic acids equivalent ?

It is the non-dissociated form of organic acids that inhibits bacteria (AH and not (A- & H+)) because it enters the cells. Therefore, at acidic pH, organic acids are more effective against bacteria, as they are less dissociated than at neutral pH and enter the cells better.

Why are bacteria inhibited at acidic pH ?

- Change in the availability of environmental metals (enzyme co-factors)
- Change in membrane permeability (cation permeations blocked by H+)
- Slow enzyme metabolism : if acids enter the cell (cf. above) cytoplasm acidifies and intracellular enzymes are no longer at optimum pH.

Can a "neutral" food be acidified ?

Yes, by adding acetic acid, lactic acid, citric acid... or by fermentation (lactic acid, alcoholic acid, ...) like yogurt, bread, wine, sauerkraut, sausage

Volatile fatty acids :

acetic acid CH₃-COOH and **acetates** (E260) for pickles, marinades (fish) in vinegar.

Calcium propionate CH₃-CH₂-COOH E280 is an antifungal for pastries under plastic, no effect on baking powder.

Sorbic acid E200 and **benzoic acid** E210 C₆-COOH-cycle inhibit mould and yeast.

Added **ascorbic**, **citric** E330 and **lactic acid** decrease pH.

Fermentations :

Natural **propionic acid** of gruyere cheese anti-mould.

Natural **lactic acid** of yogurt.

Cabbage **acetic acid**.

No toxicity.

Alcohols :

Fermented foods are preserved (the wine contains more than 10% alcohol and its pH 4). Pastries containing a little alcohol added do not mould.

Fairly strong toxicity.

Acidity, pH: Limit values :

- No microbial development if pH < 1.5
- No development of pathogenic bacteria if pH < 4.5

MARINADES in VINEGAR JARS

Principle: Obtain an acidic medium to inhibit the growth of micro-organisms.

Tip : Use a good vinegar for an optimal taste.

If no cooking in the preparation :
Marinade 2 weeks in the refrigerator and use within 3 months.

