**Aldehydes**

Aldehyde is an organic compound containing a formyl group. This functional group, with the structure R-CHO, consists of a carbonyl center (a carbon double bonded to oxygen) bonded to hydrogen and an R group, which is any generic alkyl or side chain. The group without R is called the **aldehyde group** or **formyl group**. Aldehydes differ from ketones in that the carbonyl is placed at the end of a carbon skeleton rather than between two carbon atoms.

**Examples of Application of aldehyde:**

✧ **Medical Aspect**

1. **Formaldehyde** kills most bacteria, and so a solution of formaldehyde in water is commonly used as a **disinfectant**.

2. **Aldehyde treatments** to cardiovascular devices. Aldehyde treatment of natural tissue creates cross-links in the collagen molecules while retaining mechanical strength and collagen structure.

✧ **Industrial Aspect**

3. **Benzaldehyde** is commonly employed as a commercial **food flavourant** (almond flavour) or industrial solvent, benzaldehyde is also used in the synthesis of other organic compounds, ranging from pharmaceuticals to plastic additives. It is also an important intermediate for the processing of perfume and flavouring compounds and in the preparation of certain aniline dyes.

4. **Cinnamaldehyde** has its most obvious application of **flavouring**. Concentrations required for flavoring food items like chewing gum, ice cream, candy, and beverages range from 9 to 4900 ppm (that is, less than 0.5%). Cinnamaldehyde is used in some perfumes of natural, sweet, or fruity scents. Almond, apricot, butterscotch, and other aromas may partially employ the compound for their pleasant smells. Cinnamaldehyde is also used as a fungicide. Proven effective on over 40 different crops, cinnamaldehyde is typically applied to the root systems of plants. Its low toxicity and well-known properties make it **ideal for agriculture**. To a lesser extent, cinnamaldehyde is an effective insecticide, and its scent is also known to repel animals like cats and dogs. Cinnamaldehyde is also known as a corrosion inhibitor for steel and other ferrous alloys in corrosive fluids. It can be used in combination with additional components such as dispersing agents, solvents and other surfactants.

5. **Aldehyde** was first **used in perfume** with the iconic fragrance, Chanel No 5.
Perfumes built around this fragrance additive are able to be worn year round and convey a modern, complex bouquet. Aldehyde varietals are geared towards sweet fragrances perfumes, usually marketed to women.

6. **Amyl aldehyde** can also be used in the production of diamyl phosphorodithioic salts in the leather processing and lubricating oil additive sectors.

✧ **Other Uses**

1. Aldehydes are particularly useful in pathological, biological, microbiological and dissecting laboratories because of their quick, effective kill of all pathogenic organisms.

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**Summary to the application of aldehyde**

Oxidation of aldehydes yields acids; reduction produces alcohols. They participate in many chemical reactions and readily undergo polymerization into chains containing tens of thousands of the monomer molecule. The combination of aldehydes (e.g., formaldehyde) with other molecules results in several familiar plastics. Many aldehydes are large-scale industrial materials, useful as solvents, monomers, perfume ingredients, and intermediates. Many sugars are aldehydes, as are several natural and synthetic hormones and compounds such as retinal (a derivative of vitamin A, important in vision) and pyridoxal phosphate (a form of vitamin B6).

One of a class of organic chemical compounds represented by the general formula RCHO. Formaldehyde, the simplest aldehyde, has the formula HCHO, where R is hydrogen. For all other aldehydes, R is a hydrocarbon radical which may be substituted with other groups such as halogen or hydroxyl (see table). Because of their
high chemical reactivity, aldehydes are important intermediates for the manufacture of resins, plasticizers, solvents, dyes, and pharmaceuticals.

At room temperature formaldehyde is a colorless gas. The other low-molecular-weight aldehydes are colorless liquids having characteristic, somewhat acrid odors. The unsaturated aldehydes acrolein and crotonaldehyde are powerful lacrimators. The important reactions of aldehydes include oxidation, reduction, aldol condensation, Cannizzaro reaction, and reactions with compounds containing nitrogen.

Because of the importance of aldehydes as chemical intermediates, many industrial and laboratory syntheses have been developed. The more important of these methods include catalytic dehydrogenation of primary alcohols, oxidation of primary alcohols, oxidation of olefins, and hydroformylation of olefins.

Of all aldehydes, formaldehyde is produced on the largest scale, about 6,000,000 tons per year. It is mainly used in the production of resins when combined with urea, melamine, and phenol (e.g., Bakelite). It is a precursor to methylene diphenyl diisocyanate ("MDI"), a precursor to polyurethanes. The second main aldehyde is butyraldehyde, of which about 2,500,000 tons per year are prepared by hydroformylation. It is the principal precursor to 2-ethylhexanol, which is used as a plasticizer. Acetaldehyde once was a dominating product, but production levels have declined to less than 1M tons per year because it mainly served as a precursor to acetic acid, which is now prepared by carbonylation of methanol. Many other aldehydes find commercial applications, often as precursors to alcohols, the so-called oxo alcohols, which are used in detergents. Some aldehydes are produced only on a small scale (less than 1000 tons per year) and are famously used as ingredients in perfumes and flavors. These include cinnamaldehyde and its derivatives, citral, and lilial.
Cinnamaldehyde
IUPAC name
(2E)-3-phenylprop-2-enal

Cinnamaldehyde is the organic compound that gives cinnamon its flavor and odor. This pale yellow viscous liquid occurs naturally in the bark of cinnamon trees and other species of the genus *Cinnamomum*. The essential oil of cinnamon bark is about 90% cinnamaldehyde.

Cinnamaldehyde is most economically obtained from the steam distillation of the oil of cinnamon bark. The compound can be prepared from related compounds like cinnamyl alcohol.

**Application of Cinnamaldehyde**

1. **As a flavorant**
   
The most obvious application for cinnamaldehyde is as flavoring in items like chewing gum, ice cream, candy, and beverages range from 9 to 4900 ppm (parts per million) (that is, less than 0.5%). It is also used in some perfumes of natural, sweet, or fruity scents. Almond, apricot, butterscotch, and other aromas may partially employ the compound for their pleasant smells. Cinnamaldehyde can be used as a food adulterant; powdered beechnut husk aromatized with cinnamaldehyde can be marketed as powdered cinnamon.

2. **As an agrichemical**
   
Cinnamaldehyde is also used as a fungicide. Proven effective on over 40 different crops, cinnamaldehyde is typically applied to the root systems of plants. Its low toxicity and well-known properties make it ideal for agriculture. Cinnamaldehyde is an effective insecticide, and its scent is also known to repel animals like cats and dogs. Cinnamaldehyde has recently been recognized as a very effective insecticide for mosquito larvae. As little as 29 ppm (parts per million) of cinnamaldehyde kills half of *Aedes aegypti* mosquito larvae in 24 hours.

3. **As an antimicrobial**
   
Another use for cinnamaldehyde is as an antimicrobial. Researchers from the University of Illinois at Chicago (who were funded by the Wm. Wrigley Jr. Company) have found that cinnamic aldehyde, when used in Big Red, prevented oral bacterial growth by more than 50 percent. It is especially effective against bacteria living at the back of the tongue, reducing anaerobic bacteria populations by about 43 percent.
4. **As an anti-cancer agent**

Recent research documents anti-cancer activity of cinnamaldehyde aldehyde observed in cell culture and animal models of the disease. Proliferation, invasion, and tumor growth were inhibited in a murine A375 model of human melanoma.

5. **Miscellaneous uses**

Cinnamaldehyde is also known as a corrosion inhibitor for steel and other ferrous alloys in corrosive fluids. It can be used in combination with additional components such as dispersing agents, solvents and othersurfactants.