Nowadays, carotenoids are valuable molecules in different industries such as chemical, pharmaceutical, poultry, food and cosmetics.

These pigments can act as vitamin A precursors they have coloring and antioxidant properties The carotenoid production through chemical synthesis or extraction from plants is limited by low yields that results in high production costs. This leads to research of microbial production of carotenoids, as an alternative that has shown better yields than other aforementioned. In addition, the microbial production of carotenoids, as an alternative that has shown better yields than other aforementioned. In addition, the microbial production of carotenoids could be a better option about costs, looking for alternatives like the use of low-cost substrates as agro-industrials wastes.

Yeasts have demonstrated to be carotenoid producer showing an important growing capacity in several agro-industrial wastes producing high levels of carotenoids. Agro-industrial wastes provide carbon and nitrogen source necessary, and others elements to carry out the microbial metabolism diminishing the production costs and avoiding pollution from these agro-industrial wastes to the environmental.

**Introduction**

Carotenoids belong to the most important components in foods. They are natural colorants, as yellow to red colors,. in terms of human health, they are among the bioactive phytochemicals credited that reduce risks for degenerative diseases such as cancer, cardiovascular diseases, macular degeneration and cataract [[1](https://microbialcellfactories.biomedcentral.com/articles/10.1186/1475-2859-13-12#ref-CR1)]. Carotenoids are naturally occurring lipid-soluble pigments, the majority being C40 terpenoids, which act as membrane-protective antioxidants scavenging O2 and peroxyl radicals; their antioxidant ability is apparently attributed to their structure. Carotenoids pigments occur universally in photosynthetic systems of higher plants, algae and phototrophic bacteria. On the other hand, in non-photosynthetic organisms, carotenoids are important in protecting against photo-oxidative damage. Thus, many non-phototrophic bacteria and fungi rely on carotenoids for protection when growing on conditions where light and air are abundant

### Microbial carotenoid production

The commercial carotenoids are obtained by extraction from vegetables [[25](https://microbialcellfactories.biomedcentral.com/articles/10.1186/1475-2859-13-12#ref-CR25)] and chemical synthesis [[26](https://microbialcellfactories.biomedcentral.com/articles/10.1186/1475-2859-13-12#ref-CR26)]. However, in the case of production and marketing of several colorants from plants origin there are some problems regarding seasonal and geographic variability that cannot be controlled [[27](https://microbialcellfactories.biomedcentral.com/articles/10.1186/1475-2859-13-12#ref-CR27)]. Own its part; the chemical synthesis generates hazardous wastes that can affect the environment. Unlike these traditional methods, the microbial production of carotenoids shows great interest and safety to use. Microbial production has the advantage to use low-cost substrates, resulting in lower costs of production. This explains the increasing interest in production of microbial carotenoids as substitutes for synthetic carotenoids used as colorants in food [[3](https://microbialcellfactories.biomedcentral.com/articles/10.1186/1475-2859-13-12#ref-CR3)]. Thus, microbial synthesis offers a promising alternative for carotenoids production.

Carotenoids are widely distributed in microorganisms including bacteria, yeast, fungus and algae*.* Commercial production of microbial carotenoids is highly efficient because they can be easily managed during the processes.

**Factors influencing the production of carotenoid in yeasts**

Carbon source is the most studied parameter to influence carotenogenesis.

Light is an important factor during the production of microbial carotenoids; hence, it improves carotenogenesis Microorganisms need to prevent themselves from the light that causes damage, and carotenogenesis is a photoprotective mechanism.

Temperature is another parameter to take into account in carotenoid production by yeasts, it affects the cell growing and metabolite production, it acts changing the biosynthetic pathways, including the carotenogenesis. The effect of temperature depends on the microorganism and the quantity of product.

Aeration is another important parameter, due to carotenogenesis is an aerobic process, and the airflow rate in the yeast culture is an essential factor to the substrate assimilation for the growth rate, cell mass and carotenogenesis. aeration rate has a significant effect on biomass and lipids production.

The development of biotechnological processes to produce carotenoid has recently increased because it is a reliable method to obtain carotenoids.

Figure.

**Metabolic engineering to production of carotenoids in yeasts**

A strategy to reduce the costs of production is the obtaining of hyper-producer strains. Metabolic engineering is the improvement of cellular properties through the modification of specific biochemical reactions or the introduction of new ones, with the use of recombinant DNA technology. The selection of appropriate microorganism is the first step in biotechnological processes, which could be undergone to mutagenesis to improve the strains and subsequently the production of metabolites.

application of metabolic engineering in yeasts, such as Sacharomyces cerevisiae and Candida utilis.

production of carotenoids as: β -carotene, lycopene or Astaxanthin by the insertion of carotenogenic genes from Erwinia uredovora, Agrobacterium aurantiacum or Xanthophyllomyces dendrorhus. These yeasts are very useful in food industries, they are considered generally recognized as safe organisms.

Bacteria such as Escherichia coli have been described as microorganisms engineered to produce carotenoid, however S. cerevisiae is considered as a safe yeast and presents many advantages as easy genetic manipulation with established host-vector systems.

**Conclusions**

Carotenoids are important molecules that improve foods quality due to their high nutritional value. For these reasons, carotenoid application as colorants has increased the interest of industries and scientists to develop lowcost process for carotenoid production. Biotechnological production mainly provides economics advantages over synthetic or extracted plant carotenoids. Yeast carotenoids have advantages such a high growth rate, decreasing the production time at industrial scale. On the other hand the use of low-cost substrates as agro-industrial wastes diminish the processes costs, and giving an alternative to the use of these wastes contributing to reduce environmental contamination.