

Yeast that Flavors Beer: Improving the Text with the Manuscript Grid

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October 25, 2023

Background

The primary challenge with Vanderhaegen, B., et al.'s "Bioflavoring and Beer Refermentation" lies in its heavy use of specific genetic terms and detailed biochemical processes. The article provides much knowledge on beer refermentation and flavoring yeasts, but its depth and complexity make it a difficult read.

Goals

The primary objective was to improve the reading experience for anyone wanting to dive into the article, whether for a class or leisure. This was to be done by employing the manuscript grid system. I could also employ any methods I wished to help break down the text and provide the reader with microbreaks to digest the text.


Brief Findings

I implemented a few main features in reorganizing the information and presenting it through a manuscript grid. The first main idea was to break down the information into separate pages so that instead of one long paragraph, it would fit over six pages.


Another feature was breaking down the bulk of the information into different levels of understanding. This would allow the reader to decide if they wanted the most basic information, a more profound understanding, or the complete picture. These sections are called "Beer Enjoyer," "Beer Maker," and "Biochem Whiz." The "Beer Enjoyer"

section only contains information that is interesting to those who drink beer, such as stating what the yeast does without explaining how.

Title

Bioflavoring and beer refermentation
Genetically modified yeasts with improved flavoring characteristics

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Introduction

Introduction
The advancement of gene technology has opened up the possibility of engineering an organism's metabolism and thus flavor production. Over the last 20 years, many examples of metabolic engineering have been described. In this paragraph, a few characteristic examples of the flavor improvement of brewer's yeast are described.

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Ester Profiles

Ester Profiles
Who are you?


Beer Enjoyer

Beer Maker


Biochem Whiz

Items made with ChatGPT4 with DALL-E 3 Plugin (chat.openai.com)


Beer Enjoyer

insights for the Beer Enjoyer
click on any bolded word to learn more
Volatile aroma-active esters, such as ethyl acetate, isomethyl acetate, ethyl caproate, and ethyl caprylate, are responsible for the fruity flavors of fermented beverages (Mølgaard 2001; Nylén 1986). However, especially in the modern beer industry, where **high-purity water** and **optimal fermentation** results are used, the ester balance is often disturbed (Anderson and Krapp 1974; Mølgaard 2001; Palmer and Renner 1974; Yoon and Stewart 1999).

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Beer Maker

insights for the Beer Maker
click on any bolded word to learn more
One way to alter the ester production is to change the synthesis rate of a certain **fungal alcohol**, which is in turn responsible for an increase in the corresponding ester level. This method was successfully used by Hata et al. (1992). To increase **isomethyl acetate** levels, they introduced extra copies of the **LEU1 gene** into the **S. cerevisiae genome**. This results in an increased production of **isomethyl alcohol** and its corresponding **acetate ester**, isomethyl acetate. A comparison **Baccharomyces uvarum** mutant was isolated by Lee et al. (1995). The mutants, which have an altered regulation pattern of **amino acid metabolism**, produce more isomethyl acetate and **phenylethyl acetate**. However, since this method also disturbs amino acid metabolism and base alcohol levels, it is not an optimal procedure with which to alter the ester levels.

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An alternative approach is the **overexpression** of one or more of the ester synthesis genes. Experiments have shown that overexpression of the **ADP1 gene** results in a strong increase in the levels of **ethyl acetate**, isomethyl acetate, and **2-phenylethyl acetate** (Fuji et al. 1994; Lily et al. 2002; Verhoeven et al. 2002b; Verhoeven et al. MS submitted). Using a combination of these mutant strains and the wild type yeast should make it possible to really modify the ester concentration in beer to a desired profile.

Biochem Whiz

insights for the Biochem Whiz
click on any bolded word to learn more
Ester formation by **S. cerevisiae** is quite a complex process. Firstly, two different co-substrates are needed for **ester synthesis**: alcohols and acids. In yeast, the acid co-substrates are activated fatty acids, and the alcohols are either ethanol or more complex **fused alcohols**, which are derived from **amino acid metabolism** (Colclough and Hammond 1994). Secondly, the formation of **volatile esters** requires **enzymatic catalysis** and different groups of esters are formed by different ester synthases (Drozdka and Hammond 1981, 1982, 1984). Molecular research has enabled the cloning and characterization of four different genes that encode ester-synthesizing enzymes: **ADP1**, **LEU1**, **ADP2**, and **ADP3** (Dufour et al. 2002; Fuji et al. 1994, 1996; Mitsuoka et al. 1992; Nagasawa et al. 1998; Yoshimoto et al. 1999).

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It is however expected that **S. cerevisiae** possesses even more, as yet unknown, ester synthesis genes (Mason and Dufour 2000). Some fermentation parameters can be adapted in order to exert a certain influence on ester formation rates (for a review, see Verhoeven et al. 2002a), but in general the complex nature of ester synthesis makes it difficult to get a tight grip on esters in **industrial fermentations**. Therefore, much research has focused on the use of mutants and genetically modified yeasts with altered ester production profiles.

The “Beer Maker” section contains further information as to how the yeast & esters work and how one would generally perform this process. Finally, the “Biochem Whiz” section contains the most scientific information that deals with genes and the science behind the processes of flavoring beer. All of this text remains the same as the original, and it was just chunked and reorganized into further sections.

We also include images on the pages for the three new sections. The photos act to indicate further what reading or understanding level the reader chose. On the latter two pages, “Beer Maker” and “Biochem Whiz,” the image also acts as a microbreak and content separator. It gives the reader time to think before scrolling to find another chunk of text.