PRODUCTION OF ENZYMES FOR BAKING: AMYLASE, GLUCOAMYLASE AND XYLANASE

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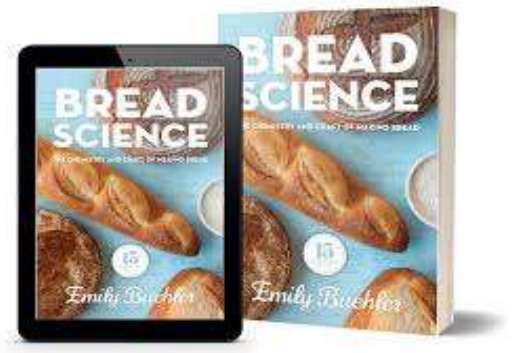
INTRODUCTION

- Bread is a baked product that comprise flour, water, yeast and other ingredients (Cauvain, 2016).
- Wheat has been the major source of starch in bread-making (Shevkani, *et al.*, 2017).
- Cassava has also become a composite source of starch used with wheat in bread-making (Adeniji, 2013).
- Leavened breads were made largely using commercial yeasts as leavening agent (Aboaba and Obakpolor, 2010).

Ingredients

Techniques



Science

Figure 1. Factors involved in creating a perfect bread

INTRODUCTION

- Why microbial enzymes?
  - Health concerns on the use of chemicals in bread making: Potassium bromate, Chlorine bleach, Azodicarbonamide, et c.
  - Final products do not show any form of post-activity.
  - Improves the baking process by reducing the time for bread preparation and staling rate
  - Balancing of flour variability (Tramper and Poulsen, 2005).

- Enzymes function in four major ways in relations to bread-making:
  - Crumb whiteners
  - Dough improvers
  - Anti-staling agents
  - Flour standardizers (Bock, 2015).

INTRODUCTION

Table 1. Some common enzymes used in bread-making, functions and impact on dough and bread

Class of Enzymes	Source	Function	Benefits in Dough	Benefits in Bread
Amylases	Malt, Microbial	Flour standardizer; Anti-staling	Generates yeast fermentation substrate	Produces reducing sugars for browning; Increase loaf volume, softer crumbs and extends shelf life
Protease	Microbial	Dough Improver	Reduce strength; Improves gas expansion an gas cell stability	Increase loaf volume, improve crumb structure; produce flavour precursors
Lipase	Microbial	Dough Improver	Better machinability; Improves gas expansion and gas cell stabilty	Produce flavour precursors; Increase loaf volume; soft crumbs with fine structure
Glucose Oxidase	Microbial	Dough Improver	Increase dough strength; Reduce stickiness	Increase loaf volume, improve crumb structure.
Xylanases	Microbial	Dough Improver	Increase dough strength; Reduce stickiness	Increase loaf volume, improve crumb structure.

(Bock, 2015).

JUSTIFICATIONS

- **Food Insecurity:** Over 26.7 million persons in Nigeria face food insecurity (Onoja, *et al.*, 2024). The project thus provides nutrient-rich bread to low-income populations and can address hunger.
- **Nutritional Improvement:** 40% of under-five year olds suffer chronic malnutrition. Enzyme-enhanced bread offers a clean label, nutritious alternative without chemical additives and thus, promotes public health (Rivera, *et al.*, 2022).
- **Environmental Sustainability:** 37% of post-harvest food is lost in Nigeria annually. Local sourcing of agro-residues and job creation in enzyme production and bread manufacturing can stimulate the economy (Gupte, *et al.,* 2023).

JUSTIFICATIONS

- **Waste to Wealth Impact:** Over 40% of root crops, fruits and vegetables get wasted in Nigeria (FAO, 2021; Kolawole, *et al.*, 2024). Local sourcing of agro-residues, including job opportunities in enzyme production and bread manufacturing can boost the economy.
- **Scalability and Market Potentials:** The global bread market is valued at $487 billion where Nigeria accounts for $2 billion and expected to grow by 11.20% annually (Statista, 2024). This project taps into the growing demand for healthier and sustainable food product in Nigeria and West Africa.

MARKET OPPORTUNITY

- The Nigerian bread/bakery sector is a multi-billion-dollar market. Market reports and industry articles place the bread/bakery market in the USD 15–19 billion range in the mid-2020s (several market overviews and press summaries project ~US$18.8B by 2025).
- The global bakery enzymes market is estimated at roughly US$0.85–1.1 billion in 2023–2024, with projected growth (CAGR ~5–9%) through the late 2020s as clean-label and industrial baking adoption rise. Major reports place 2023–2025 market sizes in the USD 0.85–1.6bn band depending on scope.
- Nigeria's food/enzyme market is forecast to expand (regional market reports project mid-single-digit CAGRs), creating growing local demand for industrial enzymes including amylases and xylanases
- Typical enzyme cost in industrial baking is a small fraction of finished-goods value. Conservatively assume **enzyme spend = 0.1%–0.5%** of bakery industry revenue Using these bounds:

Low estimate: 0.1% × US$16bn = **US$16 million** per annum.

High estimate: 0.5% × US$16bn = **US$80 million** per annum.

OUR TECHNOLOGY

- **The technologies we utilize in industrial enzyme production**
  - **Submerged Fermentation**: Liquid fermentation medium with high energy demands
  - **Solid State Fermentation**: Low water demand; low energy requirement; high product yield; improved microbial growth and flexibility in substrate use (Leveque, *et al.*, 2000).

UNIQUE VALUE PROPOSITION

- **Local production of the enzymes**: Depending on the abundance of wastes, these enzymes have been researched to be produced from agro wastes such as wheat bran, rice bran, tomato pomace, soya oil cake, brewers' spent grain et c. (Orji, *et al.*, 2014; Motta, *et al.*, 2014). This makes our enzymes uniquely cost-effective, locally produced, and tailored for Nigerian baking conditions, offering higher activity, better dough performance, and longer shelf life than imported alternatives.

- Enzyme formulation and application: The formulation of our products will involve the cocktail design of the enzymes for baking. They will be applied under controlled baking conditions that simulates standard baking procedures.

BUSINESS MODEL

FIIRO's mandate hinges on accelerating industrialization, promoting entrepreneurship and providing support for economic diversification through research and development.

On this premise, the project will:

- Carry out research and development to obtain products and also in developing necessary protocols that will optimize the use of the enzyme cocktails.
- Seek strategic partnerships with companies or entrepreneurs in the baking ingredient sector involved in white-label enzyme production for local bakery brands.
- Offer technical support services such as enzyme dosage optimization and baking performance consultation to strengthen client retention and create added value.
- Long-term growth will be driven by regional expansion into West African markets, licensing of proprietary enzyme strains, and collaboration with industrial R&D units for customized enzyme solutions.

COMPETITION

The Nigerian enzyme market is dominated by international suppliers such as Novozymes (Denmark), DuPont (now IFF, USA), and DSM (Netherlands). These companies have well-established global supply chains and advanced enzyme technologies, but their products are often expensive, with limited local customization and long lead times due to import logistics.

Our competitive edge lies in local production, which reduces cost, ensures fresh and readily available supply, and allows for tailored enzyme blends suited to the specific flour types and baking conditions in Nigeria. Additionally, by leveraging indigenous microbial strains and low-cost raw materials, we can maintain high enzyme efficiency. Easily accessible technical support, faster delivery, and sustainability through local sourcing further enhance our market advantage.

FINANCIAL PROJECTION

- The total estimated startup cost for the enzyme production project is **₦85 million (≈$55,000 USD)**. This investment covers pilot-scale equipment, facility setup, regulatory compliance, and operational expenses.
- Initial production capacity is projected at **1 ton of enzyme blend per month**, targeting bakeries and flour mills nationwide.
- Based on market demand and competitive pricing, annual revenue is estimated at **₦120–₦150 million**, with a **net profit margin of 25–30%** after the first full year of operation. Profitability is expected within **18 months**, supported by the growing substitution of imported enzyme products with locally produced, cost-effective alternatives.

FINANCIAL PROJECTION

The project seeks ₦85 million (≈ $55,000 USD) in seed funding to commercialize the local production of baking enzymes—amylase, glucoamylase, and xylanase—for Nigeria's rapidly growing bakery industry.

The investment will fund equipment and bioreactor installation (₦30M), laboratory setup and raw materials (₦15M), regulatory certification and quality assurance (₦10M), operations and staffing (₦20M), and marketing, distribution, and contingency (₦10M).

With import substitution value exceeding ₦3 billion annually, the project promises a 30–35% gross profit margin and return on investment within three years. Beyond profitability, the venture strengthens Nigeria's bioeconomy, reduces import dependence, and supports food security and industrial innovation.

TEAM MEMBERS

Name	Discipline	Role
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