

**RESEARCH AND INNOVATION SYSTEMS IN
AFRICA (RISA) PROJECT: BRIDGING THE RESEARCH
INNOVATION-INDUSTRY ASSIMILATION GAP THROUGH
TECHNOLOGY CAPACITY BUILDING IN RURAL GHANA PROJECT**



OVERVIEW OF THE TRAINING PROGRAM

This is the Research and Innovation Systems in Africa (RISA) funded project titled “**Bridging the Research Innovation-Industry Assimilation Gap through Technology Capacity Building in Rural Ghana Project**”. This training is being done by the University of Ghana Business School Innovation and Incubation Hub (UGBS Nest) in partnership with the Dairy Research Improvement and Innovation Consortium (DRIInC). The project seeks to build the capacities of rural small enterprises by training them on process enhancement innovations from the existing research and innovation knowledge available at DRIInC at the University of Ghana.

In building the capacities of local entrepreneurs, we seek to prioritize learnings towards empowering disability-owned businesses and under-represented groups of society. By delivering the project through our existing research and technology transfer infrastructure, the project widens the scope of the number of small enterprises that are likely to assimilate knowledge and innovations emanating from research communities in Africa.

The overall objective of the project is to improve the technology assimilation capacity of rural enterprises through capacity-building training across six (6) regions in Ghana. The project also aims at documenting learnings from these capacity-building approaches through building an ecosystem of hub partners and rural enterprises which continually creates the synergistic research-industry innovation assimilation loop that makes an impact beyond this project.

BACKGROUND

The innovations in food processing manuals are training manuals developed by the Research Innovation Systems in Africa (RISA) in simple terms for the average person to understand and practice. This manual was developed by faculty members from the Dairy Research, Improvement, and Innovation Consortium (DRIInC) in collaboration with the University of Ghana Business School Nest (UGBS Nest).

The training program is designed to bridge the knowledge and skills gap between traders, farmers, and small-scale food processors. Innovative processing training has been developed for dairy, egg, tomatoes, fruits, fish, and palm fruit. This training manual is designed to give step-by-step innovative ways to process these foods and scale up.

TARGET BENEFICIARIES

This training targets local entrepreneurs, disability-owned businesses, and under-represented groups of society. This will help educate them on proper food handling methods to prevent food contamination as well as processing equipment to increase productivity and save time.

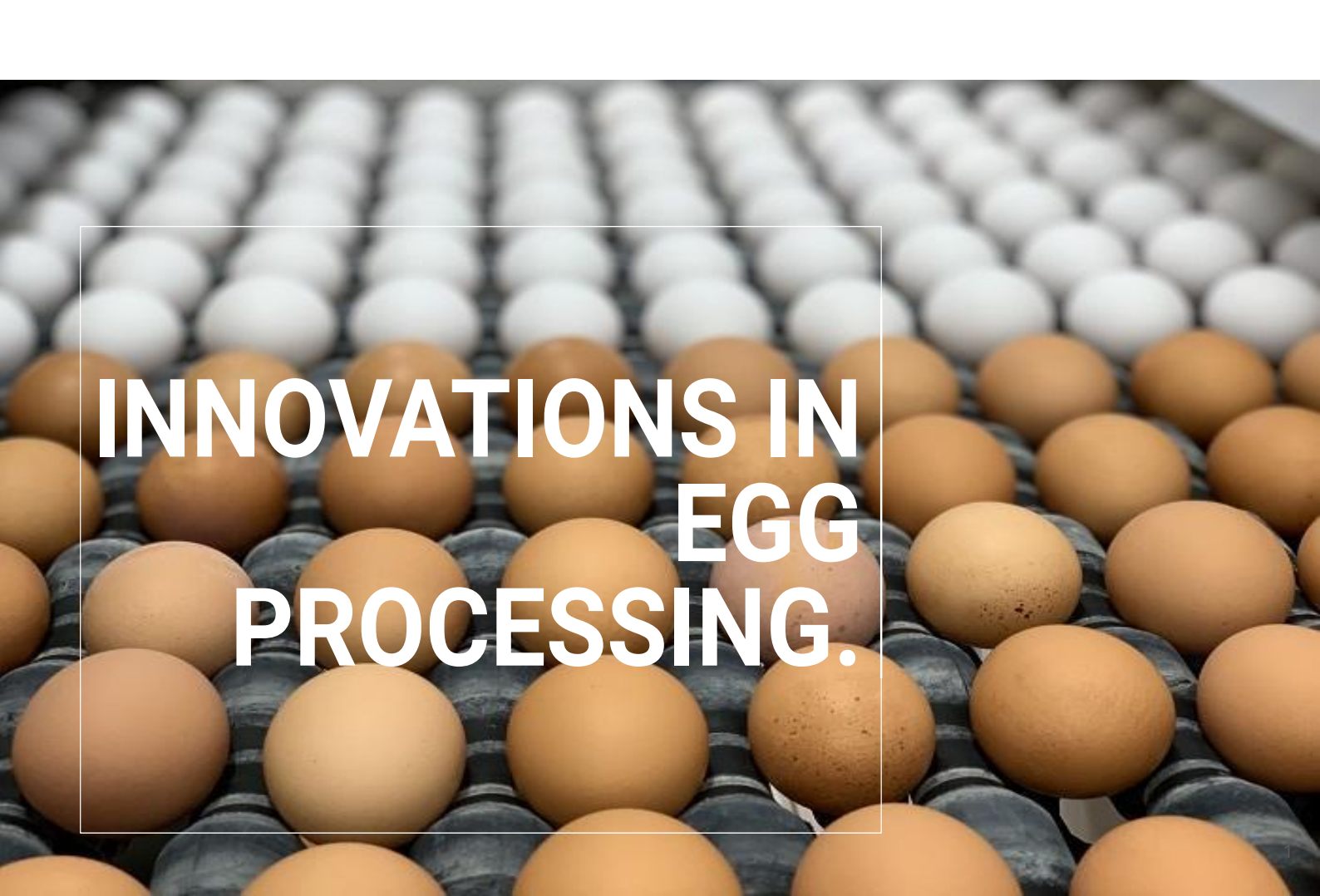
COLLABORATING DEPARTMENTS

The University of Ghana Business School Innovation and Incubation Hub (UGBS-Nest)

The UGBS Innovation and Incubation Hub (UGBS-Nest) is an initiative of the University of Ghana Business School (UGBS). The goal of UGBS Nest is to promote student innovations and technology-based entrepreneurship, thereby facilitating the practical application of knowledge for public use. The main aim of the Innovation and Incubation Hub is to provide support and training for students and innovators who are interested in converting their social and innovative ideas into startups. The UGBS Nest provides necessary infrastructural support, prototype development support, research assistance, help in getting funding, business consulting assistance, mentoring, and guidance to grow student start-ups into successful ventures. The UGBS Nest, in its quest to project the entrepreneurship and innovation development capacity of the University of Ghana and the Business School, has adopted an operational direction that fits the agenda of the University and its strategic direction.

The Dairy Research Improvement and Innovation Consortium (DRIInC)

The Dairy Research Improvement and Innovation Consortium is made up of researchers and experts from various departments and centers within the College of Basic and Applied Sciences (CBAS) of the University of Ghana. DRIInC primarily conducts research into holistic dairy production and processing in Ghana. Due to demand in the food industry, DRIInC has extended its training and research activities to cover other food and agro-processing sectors. With an increasing demand for quality food products in the country, DRIInC aims to improve the nutritional value, quality, and safety of foods through research and training of farmers and handlers of food products.

A large tray filled with rows of white and brown eggs, used as a background for the title.

INNOVATIONS IN EGG PROCESSING.

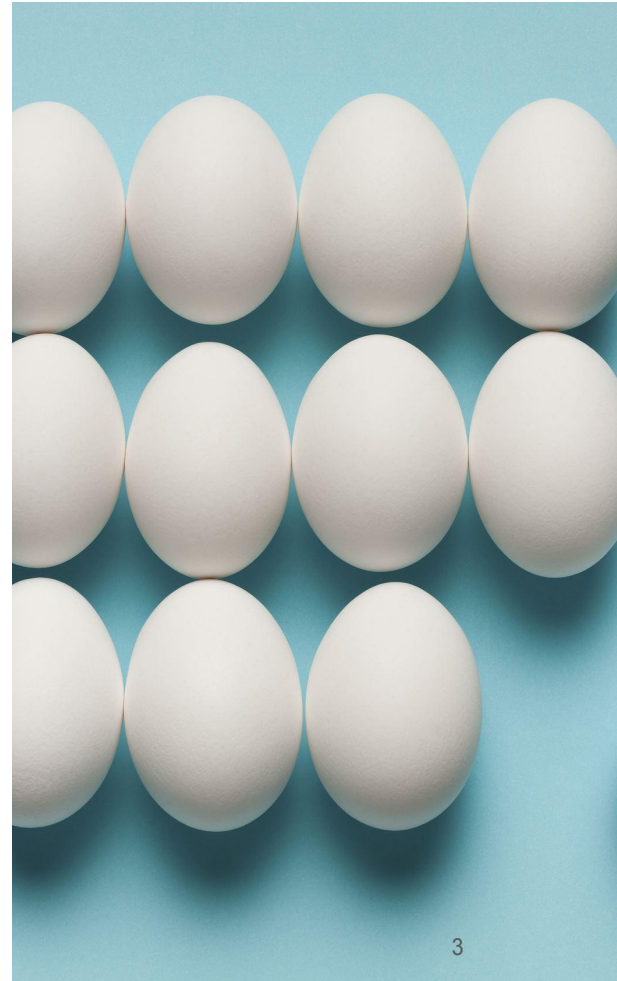
COURSE OBJECTIVES

- ❖ To give beneficiaries fundamental knowledge on food processing innovations and safety.
- ❖ Walk beneficiaries through the basics of product development
- ❖ Provide knowledge on the basic principles underlying dehydrated egg processing.
- ❖ To equip beneficiaries with the skill of processing and packaging powdered eggs.



LEARNING OUTCOMES

- Explain the importance of egg processing
- Apply the principles of product development to an egg innovation.
- Identify the unit operations involved in egg powder processing and their effect on the egg quality
- Process high quality whole egg, yolk and albumen powder.
- Determine appropriate packaging for a developed egg product.



COURSE CONTENT

INTRODUCTION TO FUNDAMENTALS OF
FOOD PROCESSING AND SAFETY

THEORY OF EGG PROCESSING AND
PACKAGING

HANDS ON DRIED EGG POWDER
PROCESSING

INTRODUCTION TO FUNDAMENTALS OF
PRODUCT DEVELOPMENT

PACKAGING CONSIDERATIONS FOR EGG
POWDER

QUALITY TESTING AND SHELF LIFE ISSUES
IN EGG PROCESSING

TEACHING PLAN

DAY 1

1. Introduction to food processing and safety
 - Food processing & Benefits.
2. Factors to remember when processing
 - Food Composition
 - Weights & Measures
 - Records
 - Price keeping
3. Quality and Testing in Food Processing
 - What is quality, why is it important?
 - Hygiene & Safety
 - Testing

DAY 2

1. Introduction to Egg processing
 - Physical Properties and Composition of eggs
 - Functional properties of eggs
 - Variations and Standardization
 - Economic importance of eggs
2. Dried egg processing
 - Introduction
 - Types of dried eggs
 - Effects of unit operations on quality
 - Materials and Equipment
3. Hands on dried egg processing
 - Materials
 - Process

5

TEACHING PLAN

DAY 3

1. Packaging considerations for powdered egg
 - What is packaging
 - Labelling
 - Packaging materials for egg powder
2. Introduction to quality testing and shelf life issues
 - Quality specifications for egg powder
 - Testing
 - Sensory test
3. Egg powder evaluation

DAY 4

1. Introduction to Fundamentals of Product Development
 - What is product development
 - Importance of product development
 - Approaches to product development
 - Product development process

6

Introduction to food processing and safety

7

What is food processing?

Food processing refers to a group of procedures or processes used to change food from its original form into one that may be consumed by either people or animals. Food processing often entails transforming raw food ingredients into consumable, enticing, marketable, and long-lasting products.

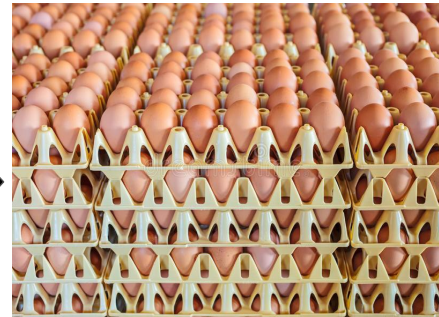


8

Benefits of processing



Shelf life extension



Food security



Value addition & Nutrition



Convenience



Quality improvement

Factors to Remember when Processing

There are four major considerations that must be made for effective processing and profitability:

1. Food composition
2. Weights and Measures
3. Records
4. Price Keeping

1. Food Composition

Component of food

The component of food may be grouped into major and minor.

Major

- Carbohydrates
- Proteins
- Fats
- Water

Minor

- Vitamins (A,B,C,D,K)
- Minerals (Calcium, iodine, iron)



Properties of Carbohydrates

Sugars

- Sweet
- Caramelize under heat
- Easily ferment
- Good preservative



Starch

- Not double in cold water
- Pasty



Cellulose

- Resistant to breakdown
- Insoluble in cold water



Pectin

- Gummy
- Imparts viscosity in tomatoes
- Can form gels with acids



Properties of Proteins

- Foaming
- Coagulation
- Flavor
- Gelling



13

Properties of fats

- Browning
- Emulsification
- Shortening
- Lubrication



14

Water

- Water is important for maintaining the proper function of the body.
- In processing, water affects

i. Processing method

ii. Shelf life



15

Vitamins and Minerals

Nutritionally, these components are required in small quantities by the body

In food processing they have important functional properties are used additives to serve as:

- Antioxidants
- Colorants
- Flavorants



Sobolo

16

Food Types

Animal food and products

- Meat
- Poultry
- Pork
- Fish
- Milk
- Cheese (wagashie)



Starchy roots, tubers & plantains

- Yam
- Coco yam
- cassava
- plantain



Cereals & Grains

- Maize
- Rice
- Wheat
- Millet
- Sorghum



17

2. Weight & Measures



Digital weighing scales



Food thermometer



Measuring cup



Measuring spoons

18

3. Records & Price keeping

Records promote traceability and provide documentation that the food business has followed appropriate practices. Another legal requirement is that food firms maintain records relating to the manufacture, processing, packing, distribution, receipt, holding, or importation of food products. Records kept include:

- Receival records
- Raw material issue records
- Product formulation record
- In-process record
- Cleaning records
- Booking keeping



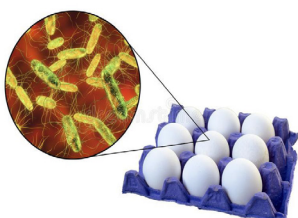
Food safety and hygiene

Food Safety: The guarantee that when food is prepared and/or consumed according to its intended usage, it won't have a negative impact on the consumer's health.

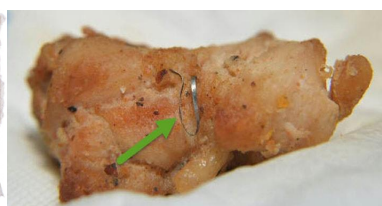
Food hygiene: Every circumstance and action required to ensure that the food is safe and acceptable at every stage of the food chain.

Food Hazard: A biological, chemical or physical agent in food with the potential to cause an adverse health effect.

Biological



Physical



Chemical



Good Hygiene Practices (GHPs)

- GHPs are basic measures and conditions applied at any step within the food chain to provide safe and suitable food. They are requisites to producing standard quality food product.

Person

- Personal hygiene



Place

- Storage environment



- Production area



21

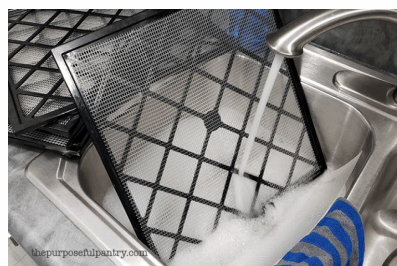
Materials & Equipment



- use of right equipment
- ensure the sanitation of each equipment before and after production



- use of clean and quality raw materials



- use of right cleaning tools and chemicals

22

Introduction to Egg processing

23

Composition of Eggs

In Ghana, eggs are mainly sourced from poultry. They are composed of shell, yolk and albumen.



24

Composition of Eggs

Composition:

- Proteins 13%
- Carbohydrates 1%
- Fats 11.5%
- Water 73.5%
- Mineral 1%

Other components include calcium, iron, zinc, vitamins and folic acid.

Stadelman & Cotterill, 1995.

25

Functional Properties of eggs

Properties of egg that makes them versatile in foods include

- coagulation



- foaming



- emulsification

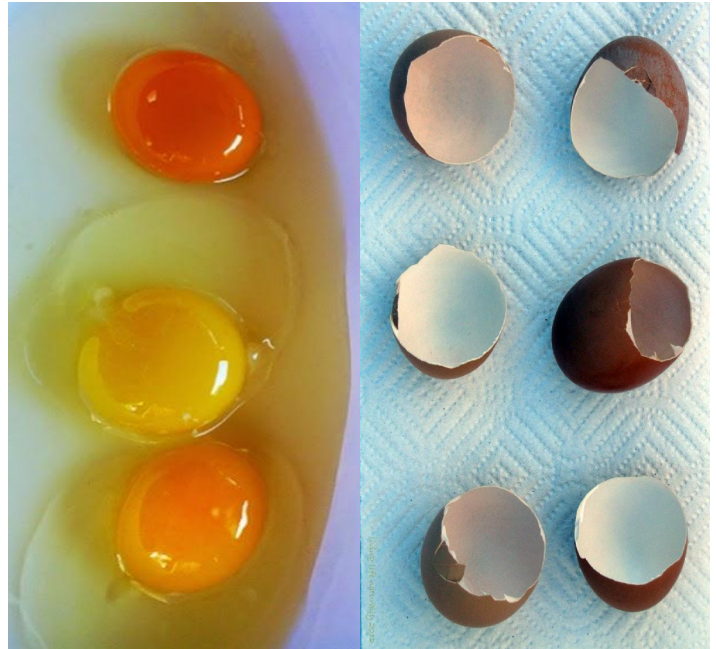


26

Variation & Standardization

Factors to consider

- Source
- Breed of bird
- Feed
- Age of egg
- Processing factors



27

Economic Importance of eggs

Eggs are used in:

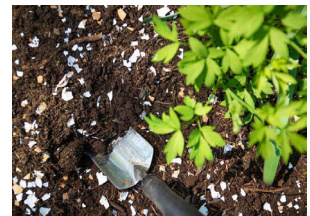
- Food Application



- Animal feed



- Fertilizer



- Manufacturing



- Medical & Pharmaceutical



Dried Egg processing



29

Introduction

- Dehydration can be applied to **whole eggs**, **egg yolk** or **albumen** with no or negligible changes in functional and nutritional properties, making them comparable to fresh eggs.
- Powdered eggs can be rehydrated for use as fresh eggs. In mayonnaise, salad dressings, confections, pasta, and many convenience meals, egg powders are frequently utilized.

Types of dried egg powders

1. Plain-Dried Whole, Yolk & Albumen
 - a. Pan-dried white
 - b. standard whole/standard yolk
 - c. stabilized (sugar -free) whole/yolk/albumen
2. Dried-Blends of Whole and Yolk with Carbohydrates
 - a. Whole/ yolk with sucrose/corn syrup
 - b. Yolk with corn syrup
3. Speciality Dried Egg
 - a. mix
 - b. low cholesterol

31

Effects of units operations on powdered eggs quality

- The major unit operations involved in egg powder processing are **breaking, pasteurization, homogenization** and **dehydration**.
- Egg proteins coagulate above 60 °C. Eggs will therefore have to be dehydrated below 60 °C to ensure that they rehydrate in their raw state
- The microorganism of concern, Salmonella sp., dies above 60 °C. Powdered product will therefore need to be pasteurized before packaging

32

Effects of units operations on powdered egg quality

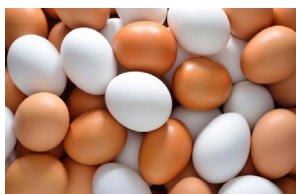
- Pasteurization can be done at 61 °C for 3.5 mins for yolk and whole eggs and 56°C for albumen to rid salmonella
- Tray drying results in 1.5-12.5 mm flakes which are further grinded into a fine powder.
- The final product has about 6-8% moisture content.
- The shelf life of powdered eggs is averaged around **1 month** without refrigeration and **1year** in refrigerator

33

Materials & Equipment



Dehydrator



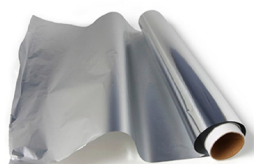
Eggs



Grinder



Net strainer



Aluminum foil



Cellophane bags

Materials & Equipment



Blender



Cooking gloves



Vacuum sealer



Weighing balance

35

Egg Powder Processing

Stage: Pre-Processing

1



♠ Wash and Wipe eggs

♠ Break eggs into a clean bowl



♠ Carefully separate yolk and albumen for separate powders.

36

Egg Powder Processing

Stage: Quality Control

2



- ♠ Smell and visually inspect to ensure there are no off odors, shell fragments or other particles in egg.

37

Egg Powder Processing

Stage: Processing-Mixing

3

- ★ Gently **whisk** the eggs (or yolk) for a uniformity in consistency and coloration of dried products
- ★ While over-mixing can make mixture runny, under-mixing will affect drying time hence overheating.



38

Egg Powder Processing



- ★ Measure the volume/weight of mixture using a measuring cup/balance
- ★ Thinly spread the mixture on dehydration trays.

Stage: Processing-Weighing & Pouring

4

This stage is critical prior to dehydrating.

Mixture should be just thin enough to cover tray.

The quantity will affect dehydration time and quality of dried product.

39

Egg Powder Processing

Stage: Processing-Dehydration

5



- ★ Gently place tray inside the dehydrator
- ★ Set the dehydrator at **55 °C** (for whole egg or yolk) and **50 °C** (albumen) for **13 hours**.
- ★ Resulting product must be completely dried and **flaky** indicating a well done spreading otherwise mixture will be **pasty** rather than flaky.

40

Egg Powder Processing

Stage: Processing

6

Grinding

- ★ Transfer flakes into a grinder.
- ★ Grind to obtain at high speed for 3 mins a fine powder
- ★ Fine powder leaves no residue after straining



41

Egg Powder Processing

Stage: Processing-Pasteurization

7



Pasteurize the powder:

- ★ Transfer unto a clean tray.
- ★ Heat to 61 °C and hold for 3.5 mins in the dehydrator.
- ★ This step is critical in ensuring that product is microbiologically safe.

42

Quality, Packaging and Shelf life Considerations



Packaging

Why packaging?

Packaging is a vital aspect in commercialisation as far as delivering quality products are concerned because:

- Its a quality requirement
- It protects/preserves product integrity and safety
- Promotes brand of producer or company
- Attracts consumers
- Provides relevant (nutritional) information about product
- Promotes transportation and distribution of products

Factors to consider when packaging

Many factors must be taken into consideration for packaging powdered eggs;

- quality maintenance
- storage facilities and environmental conditions
- type of transport
- distance to be travelled
- time taken (throughout the value chain)
- costs

45

Common Materials/methods

- Vacuum sealing (High/ low density polyethene bags (HDPE/LDPE))
- Fibre sacks with laminated inner
- HDPE pouches
- Glass jars (air tight)



Some Quality Specifications of Dried Egg Powder

Definitions

- ★ **Powder:** fine particle to which any dry substance is reduced by methods such as spray drying, pounding, grinding or triturating during processing
- ★ **Contaminant:** any substance not intentionally added to food, which is present in such food as a result of the production packaging, transport or holding of such food or as a result of environmental contamination.

47

- ★ **Additive:** any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, but added intentionally to achieve a specific result.
- ★ **Whole powdered** eggs contain the whole egg
- ★ **Powdered egg whites** contain just the white of the egg and work just as well in recipes as egg whites that have been hand-separated
- ★ **Powdered egg mix** is mostly whole egg powder with h added ingredients such powdered milk, vegetable oil etc.

48

General requirement for egg powders

The **eggs** used must;

- a) have the ability to produce the powder that shall be easily reconstituted
- b) not be incubator eggs
- c) not be contaminated with the egg content of dirty eggs
- d) be sourced from producers who follow egg guidelines
- e) must be washed and dried (with clean towel/tissue) before breaking



49

The **egg powder** shall;

- a) have a uniform yellow, white or orange-yellow colour and a smooth and uniform texture, shall be free from lumps and gritty material.
- b) retain the original properties of fresh egg, like solubility of protein, aerating capacity, binding power and palatability.
- c) reconstitute readily and quickly when mixed with three times its mass of lukewarm water (about 40 °C).
- d) free from unpleasant off-flavours on reconstitution.
- f) free from discoloration, pathogenic microorganisms (Salmonella), and any extraneous matter.



50

Testing

Raw egg quality test

- *Albumen integrity*
 - *yolk shape*
- *Shell strength*

Egg powder quality test

- *coagulation*
- *emulsification*
- *foaming*
- *color*
- *flavor*



51

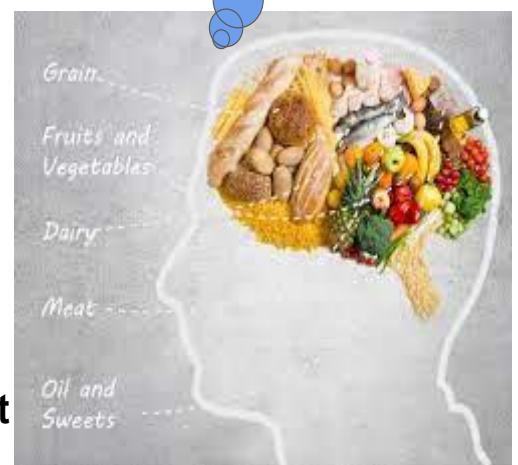
Sensory Evaluation

It is a form of food analysis that uses the five human senses to measure and evaluate food characteristics.

Importance

- Gives direction in making product decision
- Helps producer understand consumers
- Important in quality control and **product development**

"remember how you tested the quality of your eggs before processing? That was a kind of sensory test"



52

When to use Sensory :

- New product development
- Cost reduction plan(ingredient or process change)
- Packaging and shelf life tests
- Setting quality standards

Main Category

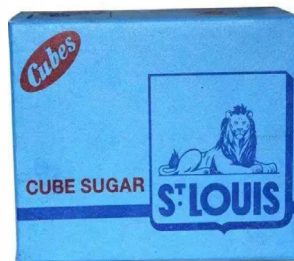
- Product oriented tests
- Consumer oriented tests

53

Fundamentals of Product Development

Introduction

What can you say about these products?



55

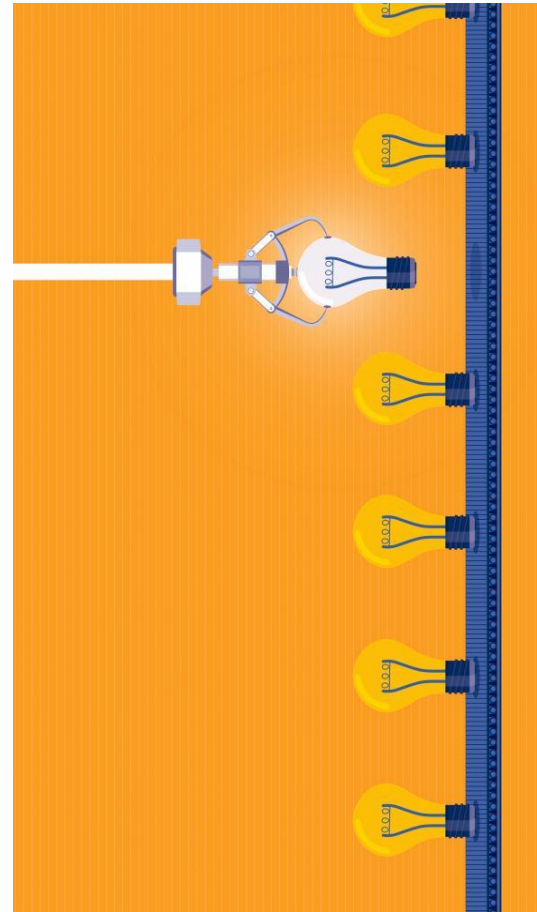
Product Development is an integrated, systematic qualitative and quantitative procedures used to create new products or improve existing ones from concept to successful as well as environmentally friendly goods

It entails **creation, enhancement, innovation** and **improvement**.

56

Why product development?

- Meet consumer needs with new products
- Generate consumer interest
- Explore market opportunities
- Create a competitive market
- Capitalize on consumer trends
- Improve production efficiencies



57

Approaches to Product Development

Consumer focused

- It is consumer centered
- Involves consumer throughout the process
- Results in product repurchase



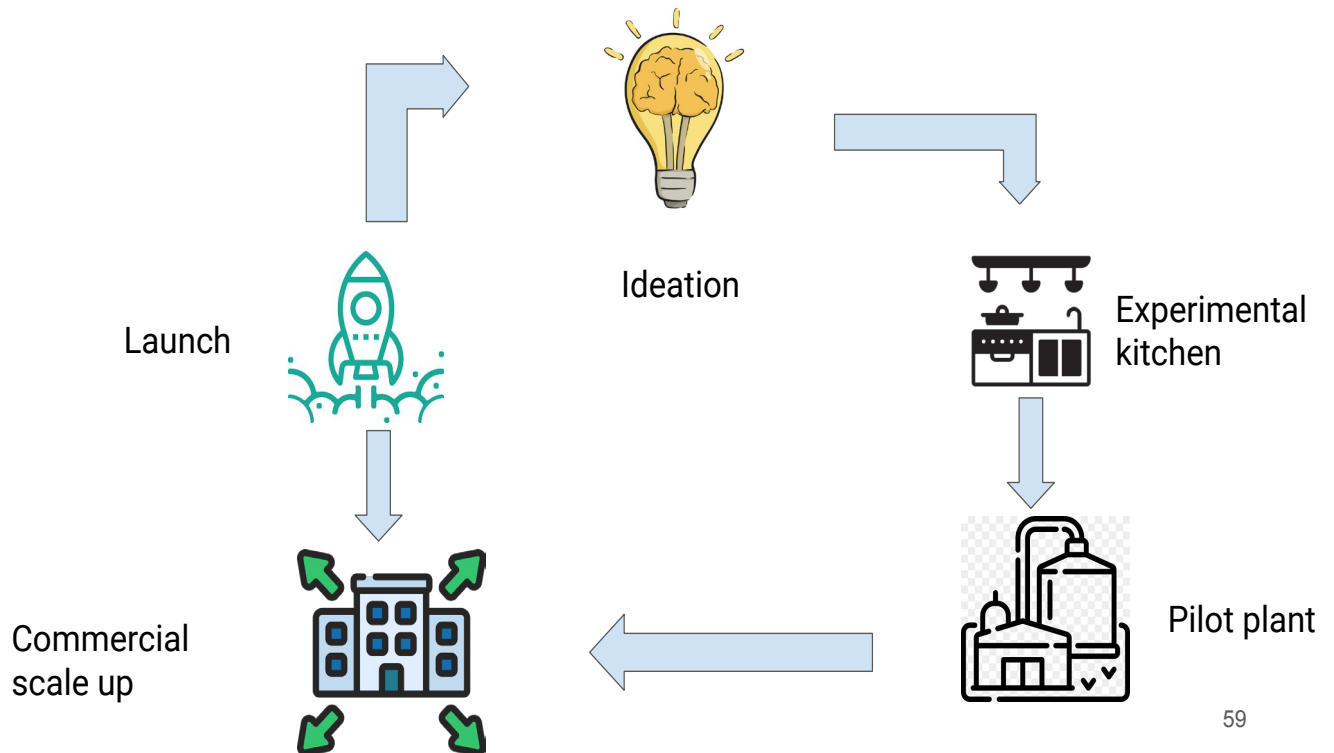
Product focused

- Development is based on product expertise and/or technology
- The consumer is made to accept the product
- Not recommended for fast moving consumer goods.



58

Product Development Process



59

Ideation: Ideas are generated from many sources (trends, research, consumers, policies etc.). At this stage, concept is unclear and must go through further probes to determine feasibility.

Experimental kitchen: This stage is where ingredient sourcing is considered as well as formulations.

Pilot plant: Similar to prototyping but emphasis on process flow and more product testing.

Commercial scale up: Development of product in larger quantities and additional testing.

Launch: Introduction to market accompanied by advertisement, sales, marketing, monitoring and evaluation.

It all about:

- Science
- Business
- Creativity

60

References

- Alexandru Usturoi, C. S. (2017). Influence of Packaging Type on the Dynamics of Powdered Eggs Chemical Composition. *Materiale Plastice*, 2(54), 380-385. Retrieved from <http://www.revmaterialeplastice.ro/>
- Guo, M. (2016). *Storage Stability Study of A Commercial Spray-Dried Hen Egg Yolk Powder*. Mufan Guo.
- Naseer Ahmed, J. S. (2013). Different Drying Methods: Their Applications and Recent Advances. *International Journal of Food Nutrition and Safety*, 34-42.
- Salinas Gonzalez, Fallon Polette, "The Effect of Storage Temperature and Time on the Quality of Spray Dried Egg Powder" (2017). LSU Master's Theses. 4583.
https://digitalcommons.lsu.edu/gradschool_theses/4583
- Stadelman, W. & Cotterill O. (1995). *Egg Science and Technology*. New York: The Haworth Press.
- United Nations Economic Commission for Europe (UNECE). (2010). *UNECE Standards Egg-2: Egg Products. Egg-2: Egg Products*. Geneva: United Nations.
- Wu, J. (2014). Eggs and Egg Products Processing. In S. J. Stephanie Clark, *Food Processing: Principles and Applications* (pp. 437-455). John Wiley & Sons Ltd.

 FOOD AND DRUGS AUTHORITY GHANA Your Well-being, Our Priority	FOOD AND DRUGS AUTHORITY	DOC. TYPE: FORM	
		DOC NO.: FDA/FER/RQT- 04	
		Page 1 of 1	Ver. No.: 01
		Effective Date: 02/01/20	
GENERAL LABELLING REQUIREMENTS FOR PRE-PACKAGED FOOD			

- Name of Product (Brand and Generic names)
- Net weight, Net volume or Drained Weight for solid in liquid medium e.g. Tuna in Brine
- List of ingredients (specific names of ingredients and/or E-numbers)
- Date of manufacture
- Best Before Date or Use by Date (*Where applicable*)
- Batch or lot number
- Country of Origin
- Name and complete address of manufacturer/agent
 - *Labels of locally manufactured food shall have in addition, the specific premises location address of the manufacturer (ie. House Number/Plot Number/ Ghana Post Digital Address)*
- Directions for use, if any.
- Any instructions for storage/handling
- Labelling shall be in English
- Labelling shall be legible and shall be of indelible ink.

These are stipulated in the FDA Guidelines for the Labelling of Pre-packaged Foods (FDA/FERD/GL-LAB/2013/02).

NB:

- ***Where a product has both Primary and Secondary Packaging, the labelling of both the Primary and Secondary packages shall conform to the FDA's requirement on labelling of food products***
- ***Documentary evidence must be provided to substantiate nutrition information and claims on labels (if any).***
- ***All vegetable oils, both imported and locally produced, are to bear the plant source of the oil and labelled as such e.g., corn oil, groundnut oil, rapeseed oil, sunflower oil, etc.***