

# Development of a HACCP system for Vegetable *Shito*

**NINA BERNICE ACKAH & ELVIS ALFRED BAIDOO**

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH – FOOD RESEARCH INSTITUTE  
GHANA

9<sup>TH</sup> SEPTEMBER, 2015

SOUTH AFRICAN ASSOCIATION FOR FOOD SCIENCE AND TECHNOLOGY  
2015 CONGRESS. DURBAN, SOUTH AFRICA



# INTRODUCTION

- Convenience foods require less preparation or efforts by the consumer before consumption
- Currently, there are more demands for convenience foods due to changes in lifestyles
- Food processors are now producing foods which meet the convenience requirements of consumers
  - Ease of opening/breaking Packaging
  - Preparation time needed
  - Efforts needed for preparation
  - Quantity per package
  - Storage needs

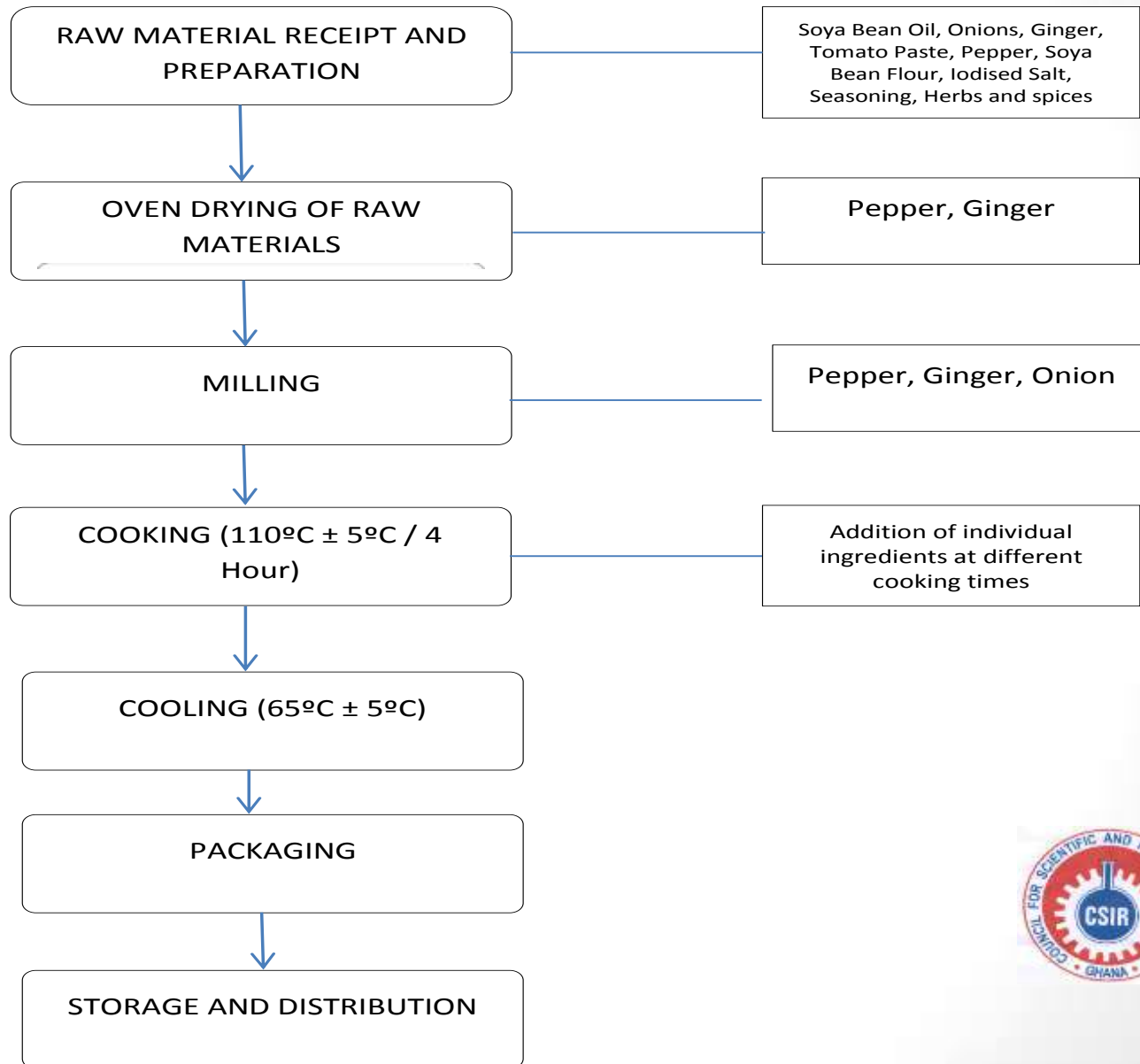


# VEGETABLE *SHITO*: WHAT IS IT?

- Vegetable *Shito* is a **spicy** smooth dark brown sauce.
- Principal ingredients are Soya Bean Oil, Onions, Ginger, Tomato, Pepper, Soya Bean Flour, Herbs and spices.
- Vegetable *Shito* is intended to be used as a Ready-to-Eat sauce which is best consumed with rice, meats, yam etc. It is suitable for Vegetarians. It is not recommended for persons below 1year



# PREPARATION OF *SHITO*



# VEGETABLE *SHITO*

Very popular among the Ghanaian populace



# VEGETABLE *SHITO* AS A CONVENIENCE FOOD

- Consumer does not need to spend too much time on its preparation
- Shift from bottles to sachets



- One-time use
- Room temperature storage



# HACCP: What does it stand for?

- HACCP is an acronym for **Hazard Analysis and Critical Control Points**
- It is a **logical, systematic, preventative** and **thorough** system designed to **identify hazards** and/or critical situations, and to produce a structured plan to **control** these situations.
- Focus of HACCP is **Food Safety**
- A HACCP plan must be **personalized** and **specific** to the individual food handling operation
- The HACCP plan must also be **user-friendly** and **dynamic**.



# THE NEED FOR HACCP FOR *SHITO*

- Commercial production and packaging of *Shito*
- Increased utilisation by restaurants
  - Prevention of liability cases
- Protection of consumer's health
  - Consumption by locals and internationals
  - Prevention of food-borne illnesses
- To meet international quality requirements
  - Export markets for economic benefits





# METHODOLOGY

- Five different *Shito* producing companies
  - Located in Accra and Tema in the Greater Accra Region of Ghana
  - Supplied *Shito* to restaurants
  - Had well-established Pre-requisite programs
    - Pests control
    - Ventilation
    - Separation of food processing areas from refuse dumps and toilets
    - Waste management
    - Cleaning and sanitation
    - Quality of raw materials
    - Storage of items
    - Personnel Hygiene
    - Personnel Training, knowledge and skills requirements



# METHODOLOGY

- Management demonstration of its commitment
- The HACCP process
  - Identification of **hazards** and their control measures
  - Determination of **Critical Control Points** (CCPs) required to control identified hazards
  - Specification of **Critical Limits** to assure that an operation is under control at a particular CCP.
  - Establishment and implementation of **monitoring systems** to observe the control of CCPs.
  - Establishment of the **corrective actions** to be taken when monitoring indicates that a particular CCP is not under control.
  - Establishment of procedures for **verification** to confirm that the HACCP system is working effectively.
  - Establishment of **documentation** concerning all procedures and records appropriate to these principles and their application.



# HAZARD IDENTIFICATION

- Hazards identified
  - *Bacillus cereus* and *Clostridium spp.* in canned Vegetables and fruits have been identified as a cause of food poisoning (Parkinson, 2009)
  - *Bacillus cereus*, *Clostridium perfringens*, and *Clostridium botulinum*, as well as non-spore-forming vegetative cells such as *Escherichia coli* and *Salmonella* have been isolated from soya powder, milled dried pepper, seasoning, herbs and spices which have all been causes of food poisoning (Ito, 2009; Pinkas et al., 2009).
  - Growth of mould prior to and after drying may also result in mycotoxin production, particularly aflatoxins in spices including pepper (ICMSF, 2011; Pinkas et al., 2009).
  - In a product such as Vegetable *Shito*, *Staphylococcus aureus*, *Clostridium perfringens*, *Clostridium botulinum* and *Bacillus cereus* are the potential hazards which could be present (ICMSF, 2011).
  - Contamination with metals from packaging material is also a possibility



# CONTROL MEASURES

- Use good quality raw materials.
- Keep foods temperature  $<5^{\circ}\text{C}$  or  $>60^{\circ}\text{C}$ .
- Physically separate raw materials from processed products.
- Use suitable hygienic equipment and processes



# CRITICAL CONTROL POINTS

- Production steps or activities where there is the need for strict control to eliminate hazards or minimise contamination
  - 1. Raw material receipt
  - 2. Cooking
  - 3. Cooling
  - 4. Packaging



# CRITICAL LIMITS FOR CCPs

Important for the measurable parameters at the CCPs. Beyond the critical limit, the CCP is deemed to be out of control and therefore the safety of the product cannot be guaranteed.



# CRITICAL LIMITS FOR CCP 1

(Venâncio and Paterson, 2007; ICMSE, 2011)

Hazard in raw material before processing	Acceptable critical limit
<i>Bacillus cereus</i>	10 <sup>6</sup> cfu/g
<i>Clostridium perfringens</i>	10 <sup>2</sup> cfu/g
<i>Clostridium botulinum</i>	10 <sup>2</sup> cfu/g
<i>Escherichia coli</i>	10 <sup>2</sup> cfu/g
<i>Salmonella</i>	Absent/25g
<i>Stapylococcus aureus</i>	10 <sup>2</sup> cfu/g
Aflatoxins B1	5µg/kg
Total aflatoxins	10µg/kg



# CRITICAL LIMITS FOR CCP 2

(CookSafe, 2005; FSAI)

- Critical Limits for cooking *Shito*
  - Important to ensure that temperature is evenly distributed
  - Minimum cooking temperature should be Ideally 110°C
  - Time of cooking after last ingredient is added should be at least 8mins.





# CRITICAL LIMITS FOR CCP 3

(USDA-NFSMI; CookSafe, 2005)

- Critical Limits for cooling
  - Rapidly cool to 63°C - 70°C within 4hrs.
  - Important to ensure even distribution of temperature



# CRITICAL LIMITS FOR CCP 4

(FSAI)

- Critical Limits for packaging
  - Complete packaging at product temperature 63°C - 70°C within 2hrs
  - Important to ensure even distribution of temperature



# MONITORING OF CCPs AND CORRECTIVE ACTIONS

CCP	MONITORING	CORRECTIVE ACTIONS
RAW MATERIAL RECEIPT	Testing/inspection of Certificate of analysis each time there raw materials are received	Reject raw materials which have hazards exceeding acceptable limits
COOKING	Use of calibrated thermometer for temperature measurement once every 2hrs and after addition of last ingredient; clock for timing cooking after addition of last ingredient and total cooking time	Adjust temperature setting and cook longer until required temperature and time is achieved
COOLING	Use of calibrated thermometer for temperature measurement once every hr; clock for timing total cooling time	Reheat product to minimum required temperature after cooking and begin cooling process again if required cooling temperature and time is not achieved. If internal product temperature does not reach 63°C – 70°C within an additional 4hrs after reheating, product should be discarded
PACKAGING	Use of calibrated thermometer for temperature measurement every 30mins; clock for timing total packaging time	Reheat product to required temperature. If temperature has been out of range for more than 2hrs, discard the product. After 2hrs, of packaging at required temperature, reheat product to required minimum cooking temperature and go through cooling process again and start packaging at specific temperature and time. After the second packaging process, discard any unpackaged product.

# HACCP PLAN

- CCP TO BE CONTROLLED
- HAZARD TO BE CONTROLLED
- CONTROL MEASURE
- CRITICAL LIMITS
- MONITORING PROCEDURES (WHAT, WHO, WHEN, HOW)
- CORRECTIVE ACTIONS
- RECORD KEEPING/DOCUMENTATION



# VERIFICATION

- Verification is the application of methods, procedures, tests and other evaluations in addition to monitoring, to determine compliance with the HACCP plan
  - Verification activities provide information concerning whether production processes and product parameters were within acceptable critical limits during processing, which will eventually guarantee the quality of the end-product
- Simply... To answer the question **‘Are we doing what we planned to do?’**



# HOW IS VERIFICATION DONE?

- **What is verified** –important factors that affect a production process
- **Methods of verification** –document analysis on data recorded at CCPs as part of the monitoring process, the results of on-line testing, end-product testing, equipment calibration checking and actual observations.
- **Responsible person** – A competent person not put in charge of monitoring and executing corrective actions
- **Frequency** – scheduled frequency
- **Documentation and record keeping** – records of verification activities
- **Verification data analysis** –to provide information concerning the performance of the HACCP and can be used for the correction and improvement of currently operating HACCP



# VERIFICATION PLAN

CCP	Verification Procedures
Raw Materials receipt	<ul style="list-style-type: none"><li>• Monthly inspection of raw material receipt documents</li></ul>
Cooking	<ul style="list-style-type: none"><li>• Inspection of calibration certificate of thermometers once every 6 months.</li><li>• Inspection of records for cooking once a day at end of production (Temperature and time of cooking)</li></ul>
Cooling	<ul style="list-style-type: none"><li>• Inspection of calibration certificate of thermometers once every 6 months.</li><li>• Inspection of records for cooling once a day at end of production (Temperature and time of cooling)</li></ul>
Packaging	<ul style="list-style-type: none"><li>• Inspection of calibration certificate of thermometers once every 6 months</li><li>• Inspection of records for packaging once a day at end of production (Temperature and duration of packaging)</li><li>• Inspection of test reports of end-products once a month</li></ul>



# VALIDATION OF HACCP PLAN

To check whether the system will work when put in practice  
Challenge testing





# Challenge testing

- Inoculation of raw materials (Ginger and pepper) with hazards (pathogens)

## Ginger

- *Bacillus cereus* ( $2.1 \times 10^6$  cfu/g)
- *Escherichia coli* ( $3.4 \times 10^6$  cfu/g)
- *Clostridium perfringens* ( $2.8 \times 10^6$  cfu/g)
- *Staphylococcus aureus* ( $3.7 \times 10^6$  cfu/g)

## Pepper

- *Bacillus cereus* ( $1.3 \times 10^6$  cfu/g)
  - *Escherichia coli* ( $2.2 \times 10^6$  cfu/g)
  - *Clostridium perfringens* ( $1.9 \times 10^6$  cfu/g)
  - *Staphylococcus aureus* ( $1.1 \times 10^6$  cfu/g)
- 
- Raw materials prepared according to preparation protocols
  - Wash 5x with running water and 1x with Vegiwash food sanitizer at the right concentration and temperature.
  - *Shito* produced according to HACCP system developed



# RESULTS

		<i>E. Coli</i> (cfu/g)	<i>Staph aureus</i> (cfu/g)	<i>Bacillus cereus</i> (cfu/g)	<i>Cl. Perfringens</i> (cfu/g)
Day 1		<10	<10	<10	<10
Day 7 after incubation @44°C		<10	<10	<10	<10
Day 7 after incubation @37°C		<10	<10	<10	<10
Day 7 after incubation @30°C		<10	<10	<10	<10



# Key issues to consider

- Supplier control
- Job descriptions
- Organogram
- Training
- Communication
- Documentation



# THANK YOU



SOUTH AFRICAN ASSOCIATION FOR FOOD SCIENCE AND TECHNOLOGY  
2015 CONGRESS. DURBAN, SOUTH AFRICA