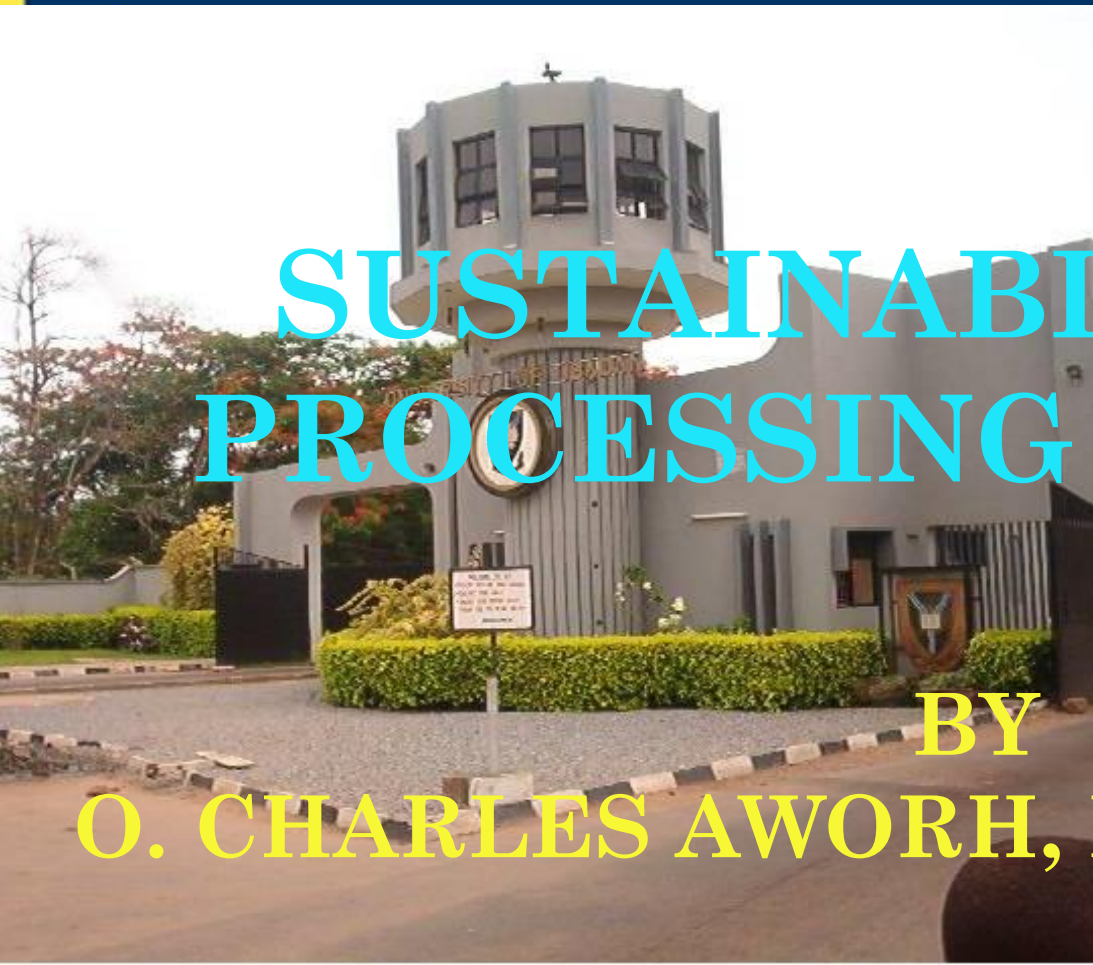


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SUSTAINABLE FOOD PROCESSING SYSTEMS

BY
O. CHARLES AWORH, FNIFST, FIAFOST



SUSTAINABILITY: DEFINITION

- Implies ability to be maintained or upheld
- Brundtland Report of 1987 “ Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Three dimensions to sustainability

- Environmental-----natural endowment, biodiversity
- Economic-----poverty and purchasing power
- Social-----culture and way of life

BACKGROUND

- Poverty and food insecurity are widespread in Nigeria.
- PEM in children and micronutrient deficiencies (VAD, IDA) remain major public health problems.
- Nigeria has one of the highest under-5 mortality in the world (168 per 1000).
- About 60-70% of the 170 million Nigerians live below the poverty line (\$1.25 a day) and are food insecure.
- Small farmers account for < 90% of food production
- Nigeria spends about \$10 billion annually on

FOOD SECURITY DEFINITION

FAO (World Food Summit, 1996):

“A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.”

USDA : Food security includes at a minimum:

- The ready availability of nutritionally adequate and safe foods
- An assured ability to acquire acceptable foods in socially acceptable ways- without resorting to emergency food supplies, scavenging, stealing etc

FACTORS CONTRIBUTING TO FOOD INSECURITY

- Poverty
- Low food production
- High post-harvest losses (30-50%)
- Seasonal food shortages (hungry season)
- High food prices
- High unemployment
- Poor health facilities
- Low level of nutrition education
- Cultural factors and taboos

TRADITIONAL AFRICAN FOOD PROCESSING TECHNIQUES

- Evolved in response to our food production systems
- Part of the culture of the people and have been in existence since ancient times.
- Constitute a vital body of indigenous knowledge used for food preservation, acquired by observation and experience (an art), handed over from parent to child over several generations.
- Regrettably, often undervalued, largely undocumented, some have been lost irretrievably.
- Time tested; more appropriate to our level of technological development, social & economic conditions.

TRADITIONAL AFRICAN FOOD PROCESSING TECHNIQUES: MAIN FEATURES

- Methods are crude and remain largely at the empirical level.
- Characterized by slow, labour-intensive, time consuming manual operations (415 man hours to process 10 tons of cassava to gari).
- Outputs are low (kg/hr rather t/hr).
- Not standardized, varies from region to region or culture to culture.
- Quality of products variable, often poor
- Women largely involved in traditional food processing.
- Not amenable to large-scale industrial production

UPGRADING TRADITIONAL TECHNOLOGY

- Upgrading traditional technology is the key to sustainable food processing systems in Africa
- The need to upgrade these technologies by modernizing the processes and introducing simple machines that reduce the drudgery, **at affordable costs**, while still retaining traditional attributes of the products, crucial to consumer acceptance, is one of the greatest challenges facing food scientists and technologists in Africa.
- Introduction of simple machines would improve the livelihood and well-being of women with attendant benefits for the family and the society at large.

OPEN AIR SUNDRYING OF CROPS

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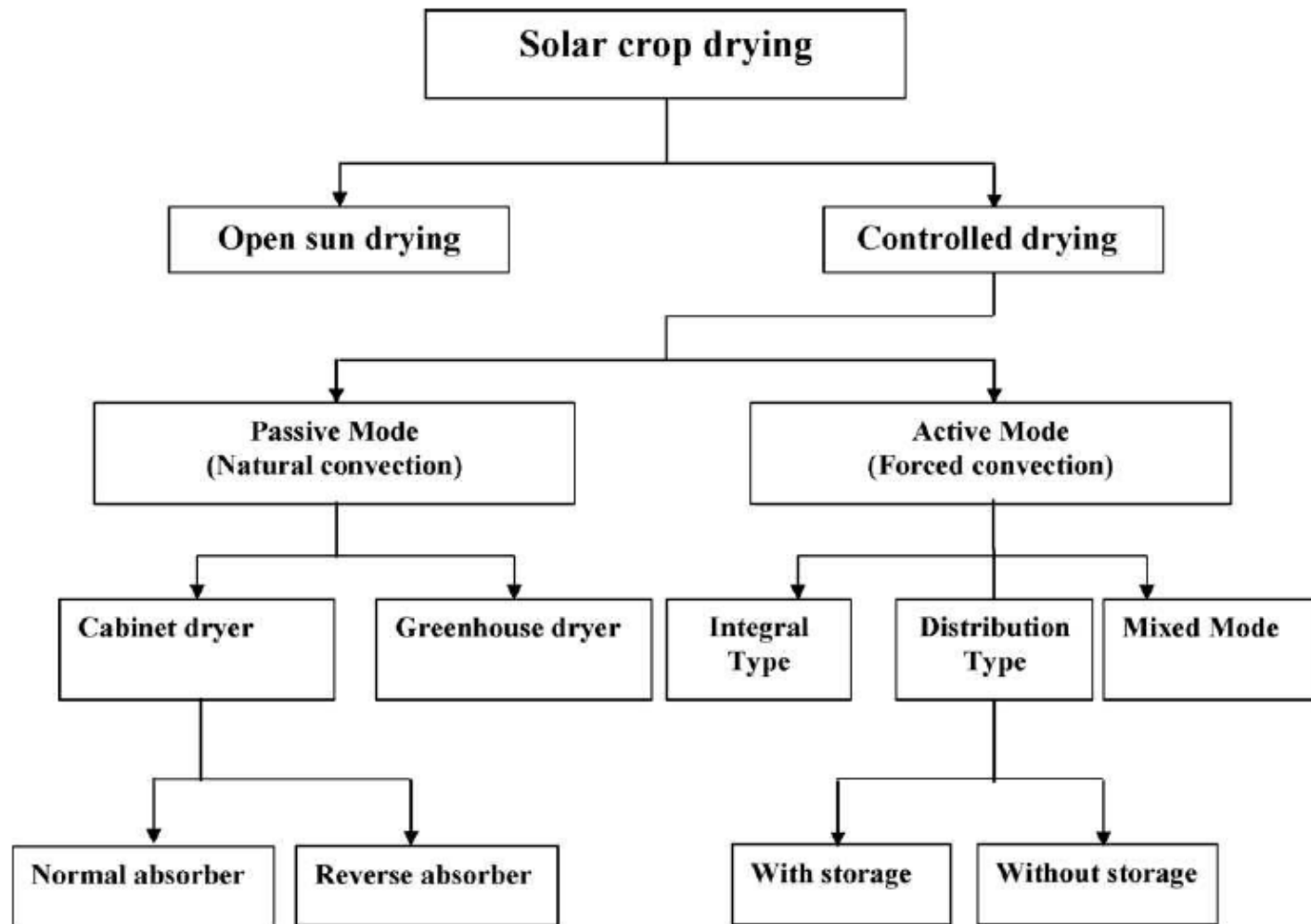


LIMITATIONS OF OPEN AIR SHALLOW LAYER SUN DRYING

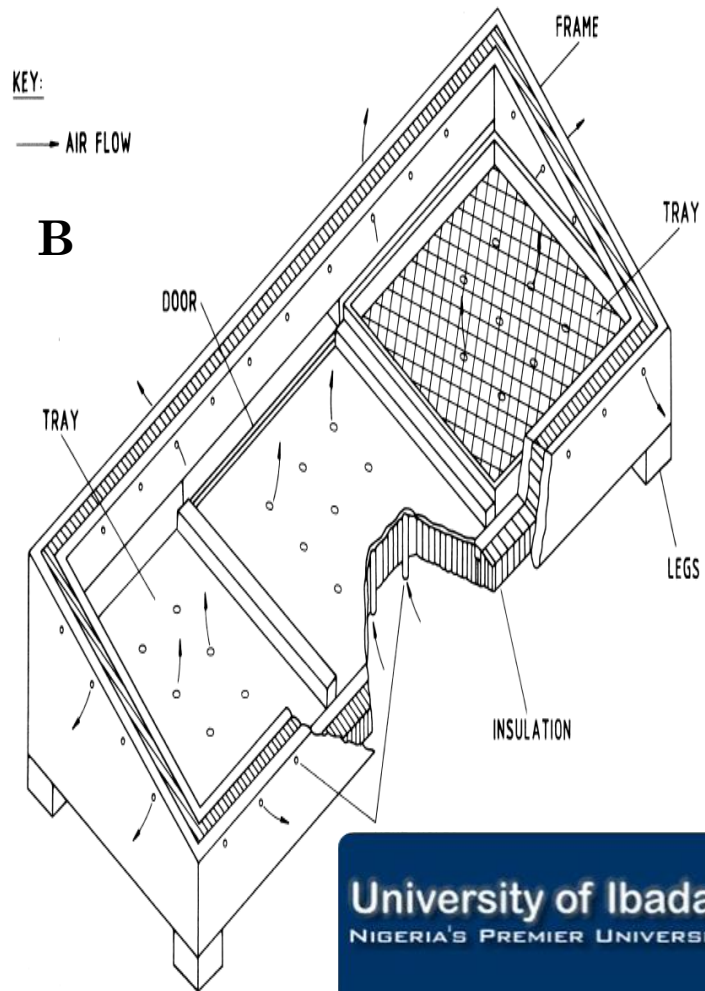
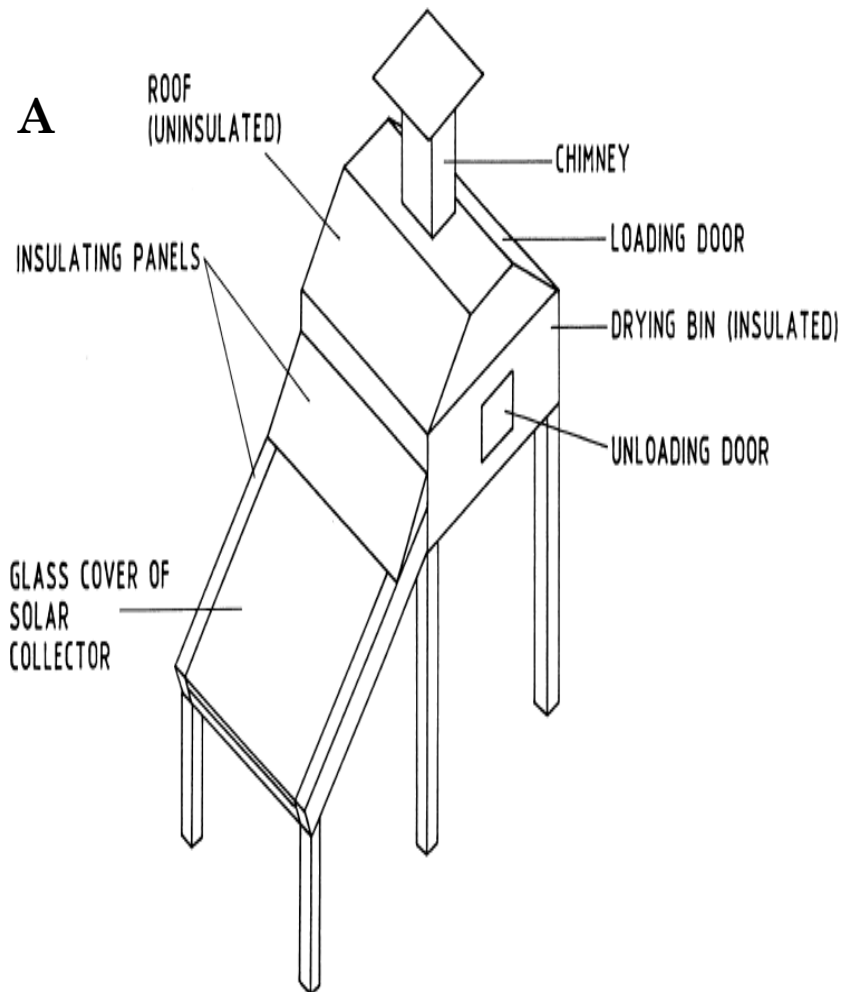
- Generally not lower moisture content below 15%.
- Long drying period required.
- Lower yield per ton for fruits and vegetables due to respiration and fermentation losses.
- Poor nutritional quality especially vitamin losses.
- Poor organoleptic quality (browning reactions).
- Wholesomeness and safety issues- exposed products contaminated by microorganisms, insects, wind borne dust, dirt, faeces etc.
- Labour intensive
- Requires considerable space.

CLASSIFICATION OF SOLAR DRIERS:

SHARMA ET AL., 2009



SOLAR DRIER DESIGN OPTIONS: DIRECT AND INDIRECT; ACTIVE AND PASSIVE



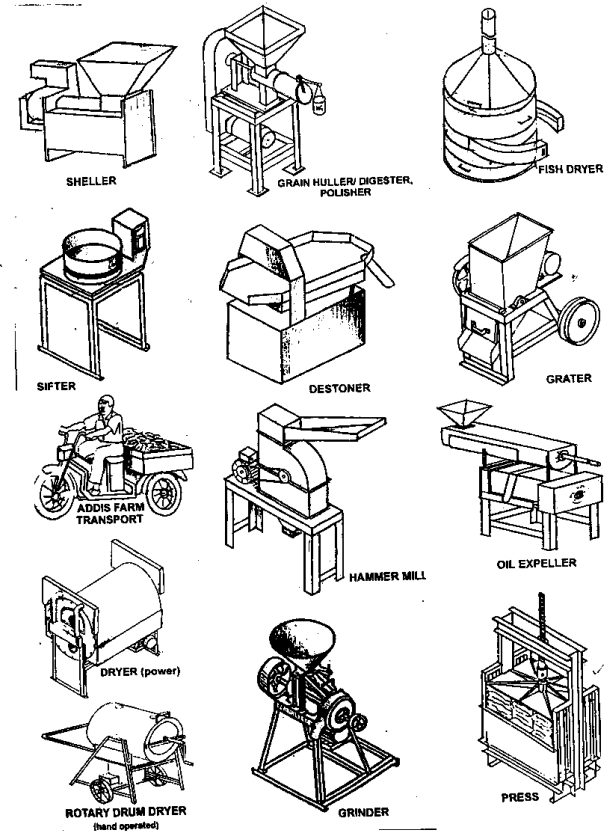
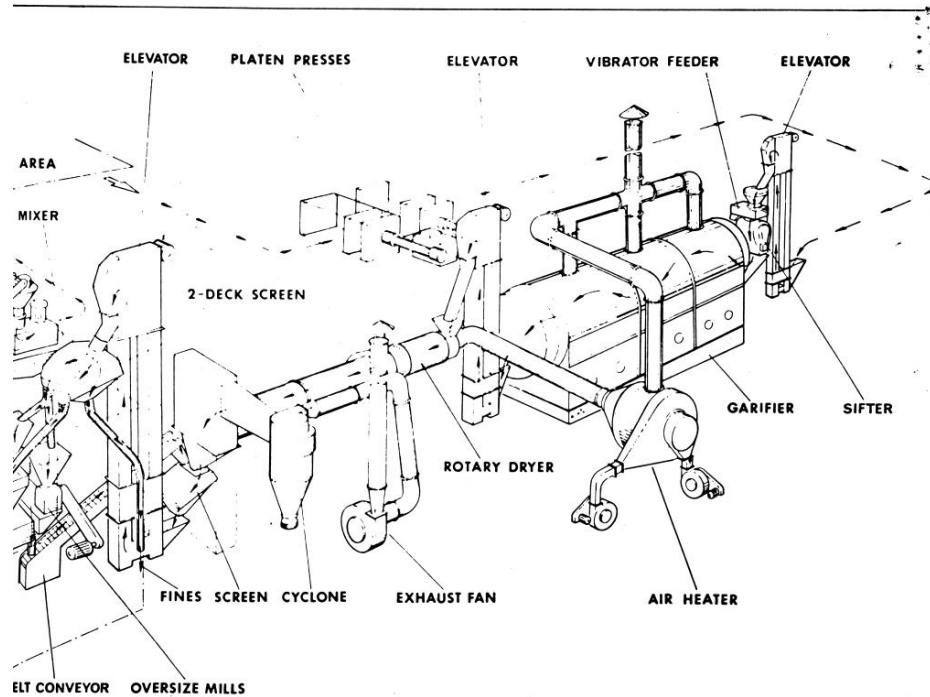
UPGRADING TRADITIONAL TECHNOLOGIES: SOME SUCCESS STORIES

- Mechanization of gari processing
- Production of instant yam flour
- Improved technology for ogi (soy-ogi)
- Improved technology for dawadawa
- Improved technology for kilishi
- Improved technology for warankasi



TRADITIONAL VS IMPROVED

POST-HARVEST PROCESSING



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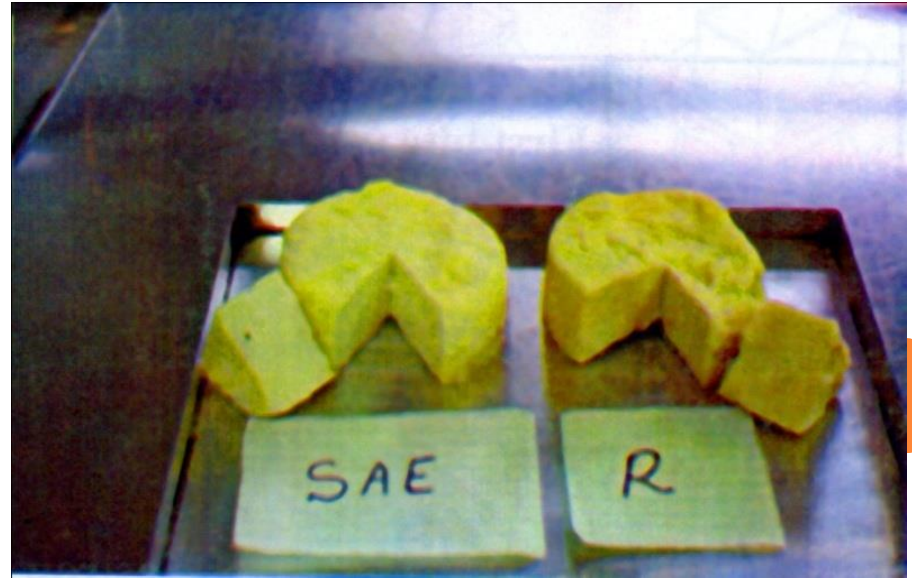
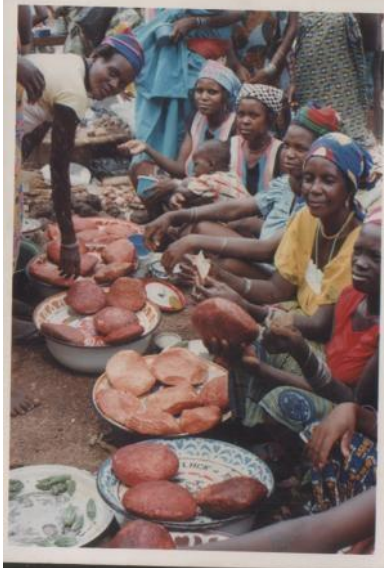
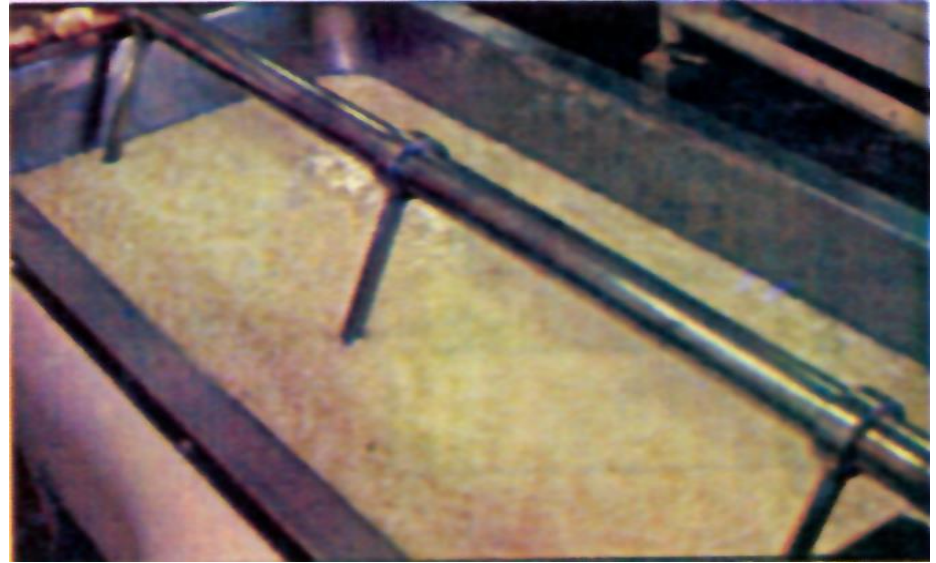


KILISHI PILOT PLAN

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TRADITIONAL VS IMPROVED



KNOWN INDIGENOUS CROPS

- There are hundreds of lesser-known indigenous crops and wild food plants that could be exploited to increase food supply and promote food security.
- Fruits and vegetables that are rich sources of essential micronutrients and nutraceuticals that play critical roles in the nutrition of the people.
- Dietary staples including cereal grains and legumes.
- Starchy roots and tubers.

SELECTED MINERAL AND VITAMIN C COMPOSITION OF SOME INDIGENOUS FRUITS AND VEGETABLES (MG/100G EDIBLE PORTION)

Fruit or Vegetable	K	Na	Ca	P	Fe	Vit-C
African pear (<i>D. edulis</i>)	142	2.3	8.4	9.5	0.2	20
African mango (<i>I. gabonensis</i>)	300	5.2	40	31	0.4	54
Hog plum (<i>Spondias mombin</i>)	288	5.6	11	33	0.3	56
Vegetable amaranth	208	92	136	26	6.4	56
Jute mallow (<i>C. olitorius</i>)	480	83	291	78	5.7	78
Fluted pumpkin (<i>T. occidentalis</i>)	154	68	75	20	9.6	129
African eggplant (<i>S.aethiopicum</i>)	483	217	378	38	18	26
Baobab leaf (<i>Adansonia digitata</i>)	391	6.0	313	85	3.9	47
Lagos spinach (<i>C. argentea</i>)	476	240	188	35	13.2	26
Roselle calyx (<i>H. sabdariffa</i>)	276	1.0	195	15	4.7	30



**AFRICAN STAR APPLE (CHRYSOPHYLLUM
ALBIDUM)**

Large
berry,
6cm long

Natural
habitat
is
lowland
rain
forest,
from
Sierra
Leone
to East
Africa



GABONENSIS)
AFRICAN OR WILD MANGO (IRVINGIA

Drupe,
unrelat
ed to
mango
(M.indic
a)

Forest
habitat
of
Africa,
Senegal
to Sudan
and
south to
Angola

SOME TRADITIONAL LEAFY VEGETABLES: BITTER LEAF, FLUTED PUMPKIN, AMARANTH, WATER LEAF



VALUE-ADDED PROCESSING

BENEFITS

- Development of value-added products is key to promoting utilization, conservation & cultivation
- Reducing of post-harvest losses
- Enhancing small-farmers' income
- Promoting sustainable rural development

FEATURES

Technologies that are used must be simple and affordable since they are targeted at:

- (i) Resource-poor farmers (<90% of production)
- (ii) Commodities with low unit value

TSAMIA: TRADITIONAL BEVERAGE FROM TAMARIND

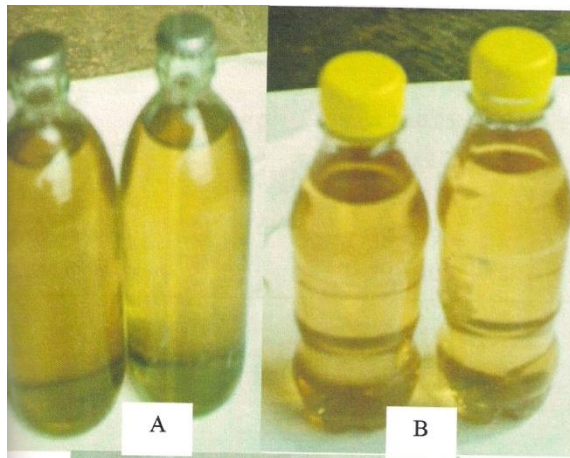
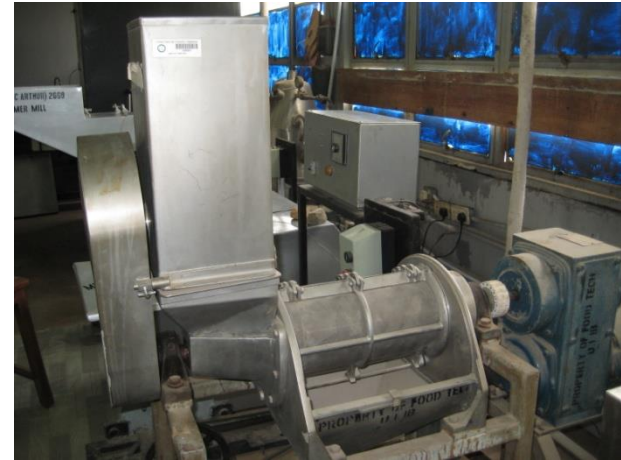


SAFETY ISSUES WITH TRADITIONAL BEVERAGES

- Traditional beverages are invariably of poor quality.
- The methods of preparation are not standardized, varying from one culture to another.
- The method of packaging invariably involves the use of discarded containers that have been previously used for other products such polyethylene or PET water bottles.
- Consequently, they are often microbiologically unsafe, have very short shelf life and have been associated with food borne illnesses such as abdominal cramps, dysentery and diarrhea.



IMPROVED TRADITIONAL BEVERAGES AND FRUIT JUICES FROM ROSELLE, AFRICAN STAR APPLE AND HOG PLUM

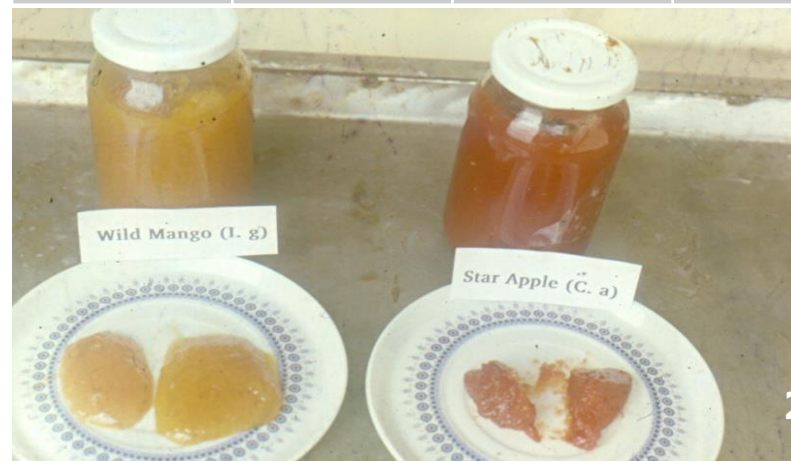


JAM-MAKING WITH INDIGENOUS FRUITS

Recipes and procedures developed for production of quality jam by open-kettle from star apple, hog plum, and wild mango (Aina, 1991; Aworh, 1997).

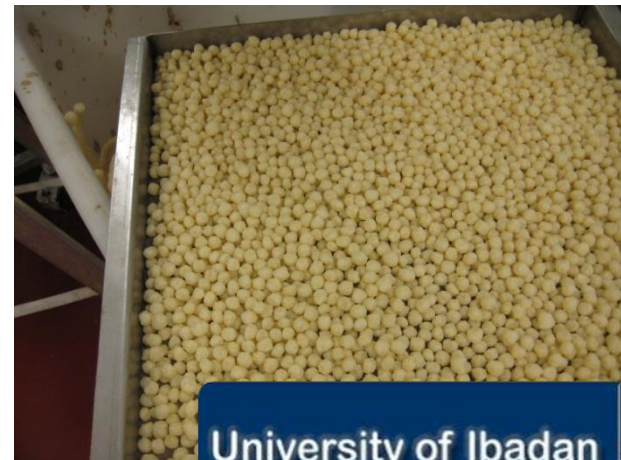


Ingred- ient	Star apple	Hog plum	Wild mango
Fruit	500	500	500
Sugar	596	626	638
water	100	100	100
Citrate	-	-	6
CaCl ₂	-	-	5





EXTRUSION PROCESSING



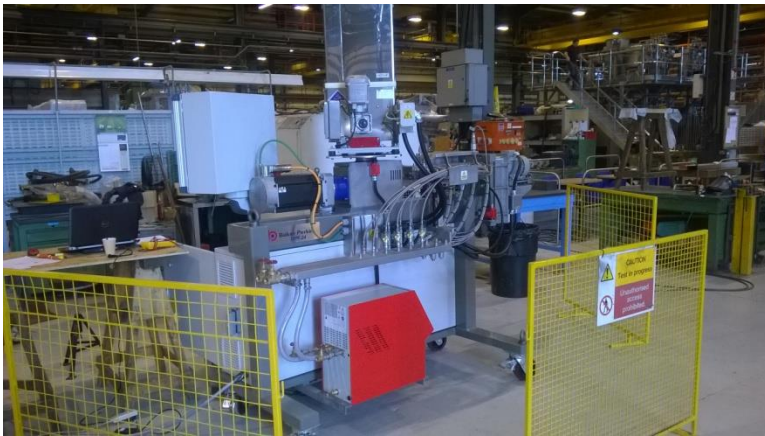
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STRENGTHS OF EXTRUSION PROCESSING

- Relatively new physical processing technique using combination of mechanical shear, high pressure and heat for producing a wide variety of novel food products.
- Versatility-pasta, complementary foods, snacks etc
- High productivity
- Relatively low cost
- High product quality
- No process effluents- environmentally friendly
- Can accomplish several functions: grinding, mixing, homogenization, shaping, hydration, expansion, texturization, partial dehydration,

BAKER PERKINS MPF 24 TWIN SCREW EXTRUDER



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CONSTRAINTS TO SUSTAINABLE DEVELOPMENT: SMALL-SCALE FOOD INDUSTRIES

Small-scale food industries are key to sustainable development in Nigeria. They are constrained by several factors including:

- Poor infrastructure especially electricity(<4,000MW in Nigeria for 170 million people)
- The use of inefficient or inappropriate technologies
- Lack of spare parts for equipment
- Poor management
- Inadequate working capital
- Limited access to banks and other financial institutions
- High interest rates
- Low profit margins

THANK YOU
FOR
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