Abstract

Indigenous fermentation technology (IFT) is employed in the production of food, condiments, beverages and wine as well as in soil improvement and waste treatment. Empirical data was generated by administering 4-point structured questionnaire to three hundred respondents randomly selected from five local government areas of Rivers State, Nigeria. The purpose was to ascertain the extent to which IFT was employed in rural households and cottage industries as well as the factors constraining the upgrading of IFT to meet the requirement of well-packaged and flavoured products obtained from well developed microbial cultures and high fermentation practices. Results indicate that IFT was employed to a large extent (>50%) in the production of various specialty goods. The prospects of upgrading IFT include enhanced food production by controlling deterioration and hence extension of shelf life, control of soil pollution, and increase in world protein supply via single cell protein. The challenges for IFT upgrade affect development in the areas of raw materials, microbial starter cultures or enzymes, fermentation process and control as well as handling of finished products. Recommendations are given to maximize the potential of IFT for national development.

Keywords: Indigenous fermentation technology (IFT), fermented food, microorganisms
Fermentation technology is the oldest of all biotechnological processes. The term is derived from the Latin verb fevere, to boil (Stanbury et al; 2008). Fermented food play significant role in socio-economic development and particularly in supply of world dietary protein requirement and hence addresses the challenges of food insecurity in a country. Bio-fermentation technology makes it possible to grow a number of fungi in large tanks and, in a matter of days, a large quantity can be produced. There are five major groups of fermentation processes, namely: those that produce microbial cells (biomass); those that produce microbial enzymes; microbial metabolites; recombinant products and those that modify a compound that is added to the fermentation–transformation process (Wikipedia, 2009).

Food security are jeopardized by pre- and post harvest losses. Some metabolites or by-products of fermentation processes are known to offer protection to plant pathogens and certain spoilage organisms. This is the basis of applying such products in pest control. Organic acids such as lactic acid and butyric acid produced by certain bacteria in fermented foods lower the pH, thus ensuring extension of storage or shelf life of the food (Rangaswami and Bagyaraj, 2005).

**Statement of the Problem**
The production of fermented food and other specialty commodities is still largely a traditional family technology done in homes in a crude manner, and consequently, the production has not increased. Food produced by farmers are sooner experience deteriorations of various kinds and hence creating losses and pocket of poverty among rural communities. Some of the identified problems for this trend include crude handling and processing techniques as well as development of appropriate starter cultures. It is believed that with increased capacity building in these areas, the potential of indigenous fermentation technology in making fostering sustainable national development especially in the area of food production can be achieved.

**Purpose of the Study**
The study was carried out to ascertain:
1. The extent to which indigenous fermentation technology (IFT) is employed among rural cottage industries or rural households in Rivers State
2. The various fermented commodities produced by rural households or rural communities and extent of production
3. The major constraints to IFT and to what extent does it militate against the upgrading of IFT
Literature Review
Meaning and Fermentation Pathways
Fermentation has been defined in several ways depending on the desired end products. Some of such definitions are chronicled in the internet. One of a central definition is that it the biochemical reaction that breaks down complex organic molecules (such as carbohydrates) into simpler materials such as ethanol, carbon dioxide, and water. NIH (2009) defines fermentation as an anaerobic process (not requiring oxygen) in which organisms convert sugars into alcohol and carbon dioxide. This process does not occur in animals but is used extensively by yeast. Humans exploit this phenomenon to make bread (the gas bubbles expand the dough) as well as wine and beer (for the alcohol produced). Substrates for fermentation are varied, ranging from edible carbohydrates to waste water obtained from their processing (see table 1). A typical pathway through which fermentation occurs for the production of some local foods such as ogi is given below:

\[
\begin{align*}
\text{Cereal grains (maize, millet, sorghum)} & \\
\text{Wash} & \\
\downarrow & \\
\text{Steep/fermentation (24-72 hours)} & \\
\text{Drain} & \\
\downarrow & \\
\text{Wet mill} & \\
\downarrow & \\
\text{Wet sieve} & \\
\downarrow & \\
\text{Ferment further (24-72 hours, optional)} & \\
\downarrow & \\
\text{Decant} & \\
\downarrow & \\
\text{Ogi slurry} & \\
\downarrow & \\
\text{Boil} & \\
\downarrow & \\
\text{Ogi porridge} & \\
\end{align*}
\]

Fig. 1: Traditional Nigerian Ogi manufacture (Banigo et al, 1974)

Scope of IFT in food production
Fermented food products can be grouped into four categories according to the main substrates or raw materials used in the processing as shown in table 1:

**Table 1: Scope of FT-processed food**

<table>
<thead>
<tr>
<th>Type</th>
<th>Name of product</th>
<th>Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fermented tubers</td>
<td>Garri, fufu</td>
<td>cassava</td>
</tr>
<tr>
<td>Fermented cereals</td>
<td>Ogi</td>
<td>Maize, millet, soybean</td>
</tr>
<tr>
<td>Alcoholic beverages</td>
<td>pito, burukulu, obiolor</td>
<td>Sorghum, rice, wheat, millet etc</td>
</tr>
<tr>
<td>Fermented legumes and oil seeds</td>
<td>dawadawa, iru, ogiri, okpiye</td>
<td>Melon, cowpea</td>
</tr>
<tr>
<td>Fermented vegetables</td>
<td>Sauerkraut</td>
<td>vegetables</td>
</tr>
<tr>
<td>Fermented animal proteins</td>
<td>nono and yoghurt</td>
<td>Milk</td>
</tr>
</tbody>
</table>

**Prospects of Upgraded Indigenous Fermentation Technology (IFT) in Nigeria**

With upgraded and improved fermentation technologies, the following prospects are envisaged: These include:

1. Industrial development in the food, beverage and health and agricultural industries
2. Soil pollution control - conversion of waste to wealth, biodegradation of wastes; bioremediation of pollutant soil and open water bodies
3. Production of biomass fuel – biogas (carbon dioxide), methane and ethanol
4. Single cell proteins e.g. mushroom,

**Challenges in Upgrading of Indigenous Fermentation Technology (IFT)**

The development of IFT can be divided into four major areas, and these present serious challenges as elucidated by various authors. These include;

1. Raw material development (Steinkraus, 1985; Okafor, 1990)
2. Development of microbial starter cultures or enzymes (Nielson, 1997)
3. Process development of fermentation process and control (Cooke, 1994)

**Methodology**

The survey design was adopted in eliciting information for the research. The study population comprised adult residents in Rivers State. A total of three hundred non-school public (rural households) and owners of fermentation-based cottage industries were randomly selected from five local government areas of Rivers State,
namely: Ogba/Egbema/Ndoni; Ikwerre; Emuoha, Abua and Ahoada-East. This constituted the study sample. To obtain data for the study, a 4-response structured questionnaire titled, “Prospects and challenges of Indigenous fermentation technology upgrading questionnaire” [PCIFTQ] was developed and administered on the respondents. The questionnaire contained fifteen items. Questionnaire items were developed based on fermentation technology issues raised by Nout (1985), Odumfa (1985); Cooke (1994) etc. Reliability of questionnai re was computed using test and re-test method with a reliability coefficient (r) of 0.75. Data was analyzed by calculating the frequency of strongly agree, agree, strongly disagree and disagree responses and hence the percentage responses.

Result

Data consists of responses obtained from three hundred respondents used for the study. Results are presented graphically according to research questions:

Research question one: What is the extent to which indigenous fermentation technology (IFT) is applied among the rural communities? Figure 2 (a) – (e) shows the frequency of responses on the scope of IFT.
Results indicate that IFT is employed severally in food and beverage production, income generation, cultural preservation and medical technology.

**Research question two:** To what extent is fermented commodities produced by rural households or cottage industries? Figure 3(a-e) indicate the percentage level of responses on IFT applications.
Results indicate that Indigenous fermentation technologies (IFT) are employed extensively in the production of various fermented foods in the area of study.

**Research question three:** To what extent is the upgrading of IFT constrained? Item 3 provides the answer to the question. The percentage responses are shown in figure 4 a-d:
Results in figure 4(a)- (d) indicate that upgrading of IFT are hampered by such factors as poor education or technical know-how of fermentation principles, lack of finance, microbial contamination, poor or inadequate storage and processing facilities and lack of market.

Discussion

Figure 2-3 show the extent of participation of the respondents in Indigenous fermentation technology (IFT). These include the use of IFT in food production, agricultural technology, medical technology, income generation through the sales of fermented foods as well as in cultural preservation (fig. 2). Among the specific areas of application include production of garri, fufu & tapioca; wine, beverages such as fermented tea and cocoa drinks, as well as yoghurt, condiments such as dawadawa from locust bean; ogiri from melon seed; and corn gruel such as ogi from maize, millet and guinea corn; soy-ogi from a mixture of soybean and maize. These findings are consistent with those of Okafor and Ejiofor (1986). Improved production of various fermented foods and condiments have been extensively studied as well as their microbiology. These include dawadawa (Odumfa, 1985); ogiri (Odumfma, 1985); ogi (Odumfa, 1987); tempe (Nout and Rhombouts, 1990); burukutu- an alcoholic beverage (Faparusi, 1970); obiolor (Achi, 1990); gari (Okafor, 1991); bread (Reilly, 2001); wine (Okara, 1994) etc. IFT is important from nutritional and health point of view: The microorganisms used to prepare and preserve food add to the
nutritive value, the flavour and other qualities associated with edibility of the product (Steinkraus, 1985; Toxicity reduction from cassava is achieved by fermentation (Barimala, 1994).

Figure 4 (a-d) shows responses on the problems militating against the upgrading of IFT in order to produce products which compete in texture, quality, shelf life and presentation to the modern-exotic fermented products from the Western market. Some of the problems identified include lack of finance, illiteracy, poor technological know-hoe of the principles of fermentation and processing as well as microbial contamination and lack of efficient storage. This finding is in agreement with those constraints identified by Nout (1985) and Steinkraus (1985) that identified inadequate raw material grading, crude handling and processing techniques, short shelf life, lack of homogeneity and unattractive presentation among some of the various factors working against traditional fermented foods worldwide.

Conclusion and Recommendations
IFT is still largely carried out in crude way in many households in Nigeria, leading to the production of sub-standard products with short shelf life. IFT is employed for the production of food and beverages, soil improvement, natural health infusions as well as a means of generating income and cultural perseveration. For IFT to be used to enhance sustainable food development, the users of these technologies have to be strengthened by developing their knowledge base in the principles and applications of modern or improved fermentation processes and techniques. These can only be achieved through the development and incorporation of fermentation biology or biotechnology into the science curriculum at all levels of education. In order to attain the desired goals, the authors hereby recommend that: the challenges thus identified in the course of the study should be addressed, as these will help in improving the present status of fermented foods in the country.
References


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