SIGNIFICANCE OF SINGLE CELL PROTEIN IN ALLEVIATING INSUFFICIENT PROTEIN SUSTENANCE IN NIGERIA

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Abstract
From the prospective of wellness, an average person requires about 70g of protein per day, and also the right quality of proteins, {first class proteins}, which provide the essential amino acids in proportion suitable for man. The first class protein are obtainable mainly from the animal sources. However, in Nigeria, about 60% of the population lives below the poverty line and could hardly afford the protein food from the animals and the alternative novel protein sources such as Soya bean, because of the high cost. Thus kwashiorkor and other protein deficiency diseases are prevalent national maladies of serious concern in the country today. Microorganisms, such as yeasts, fungi, bacteria, and algae are being developed as sources of edible proteins known as single cell protein. The advantages of SCP are that, they can be easily grow on cheap media and they grow rapidly. The paper therefore posits that the SCP is a significant protein food for alleviating protein malnutrition in Nigeria and recommends for its large scale production and usage by way of cereal food fortification in the country.

Introduction
Human beings need about forty main nutrients in their diet for normal healthy and vigorous growth, and a diet that contains these nutrients in appropriate quantity and quality is referred to as a balanced diet {Vines and Rees, 1967). Insufficiency of any of these nutrients often results in deficiency diseases that destroy population's health and working ability {Damman, 1979). Of particular significance in Nigeria in deficiency of protein, which to a large extent is responsible for clinical disease sign known as kwashiorkor. While it has been estimated that an average person requires a minimum of 70g of protein per day, in Nigeria about 60% of the population consumes less than a third of the minimum required protein per day {Nigeria Punch Newspaper of 25th Oct. 2001}. Children are particularly vulnerable to insufficient protein sustenance and more than 20 million children in Nigeria are said to suffer from serious protein deficiency {Nigeria National Planning Commission, 1992).

The basic cause of protein undernourishment in Nigeria is that the animal protein which has the capacity to supply the right quality of protein {i.e. proteins containing all the essential amino acids} needed for normal growth and development are scarce and not affordable for the majority of Nigerians who live below poverty line {Pardey, 2001). The large supply of plant proteins that is available to the poor populace are of little biological value as it is by itself nutritionally useless in the absence of the proteins from the animal sources {Anderson and Cohen, 2000).

Thus, one way of overcoming the protein undernourishment in Nigeria seems to depend on the development of cheap food concentrates of high biological value {i.e. those containing all the essential amino acids} from the plant source.

This paper, therefore, discusses the protein need and deficiency situation in Nigeria in order to show that single cell protein {SCP} is an important material for minimizing the problem of insufficient protein in the diet of Nigerians. The aim of the paper is to encourage the production and the use of the SCP in the everyday meal of an average Nigerian, in order to alleviate the protein undernourishment in the country.

Protein Needs in Human Diet
Proteins are primary constituents of protoplasm and consequently, are most important for body building, repair and formation of numerous secreted substances, particularly enzymes and hormones {Vines and Rees, 1968; Tull, 1996). Proteins are found mainly in animals and products, such as meat, poultry, fish, milk, eggs and breast milk as well as in plant foods, such as cowpeas, groundnuts and soybean {IITA, 1990). Proteins contain a large number of amino acids which are believed to be their building blocks. More than 20 amino acids have been obtained from food and body proteins. The number of ways in which they may be arranged is enormously great and the number of possible proteins is correspondingly large {Vines and Tees, 1968; and Fox and Cameron, 1.995}.

However, the value of protein food is dependent on the amount and nature of amino acids it can produce. Of the more than twenty amino acids obtainable from proteins, only ten cannot be manufactured by the human body or rather the body makes at a rate that is too slow for normal metabolism and must therefore, be
obtained in the food by man. These amino acids which man's body cannot make, that must be supplied in his food are referred to as essential amino acids. A diet that contains all of the essential amino acids is said to be of a high biological value to human body. Nevertheless, the human body can make sufficient of the other amino acids for itself, if provided with suitable starting materials. These amino acids which the body can make by itself are known as non-essential amino acids (Fox and Cameron, 1968).

Proteins from animals and dairy products are known to be of high biological value, because each one of them contains all the essential amino acids, hence they are referred to as complete or first class proteins. A diet containing the ten essential amino acids will provide a growing person with suitable materials with which to build all the amino acids needed for protein formation, for normal healthy growth and development. However, a fully grown person only requires eight of these acids (Fox and Cameron 1968; Taylor et al., 1997). On the other hand, proteins from plant foods, such as cowpea, groundnuts and soybeans are said to be of low biological value because they lack one or more of the essential amino acids, hence they are referred to as incomplete or second class proteins.

Thus, proteins from animal and dairy products such as milks, are first class proteins and can by themselves supply all the essential amino acids in required proportions for human protein needs, whereas plants are second class proteins and consequently nutritionally inadequate on their own, for they cannot by themselves be utilized for the formation of body protein. However, when eaten in conjunction with other proteins, they may complement each other and become valuable, thereby providing the body with all the essential amino acids (Fox and Cameron, 1968). It is therefore, believed that the best use is made of protein food if animal and plant proteins are eaten in roughly equal amounts, as the first class proteins will provide sufficient essential amino acids to ensure that the second class proteins from plant sources are used to the best advantage of the body while the plant food will provide the carbohydrates that enables the best use of the first class proteins for the building and maintenance of body tissue.

Protein Deficiency Situation in Nigeria

A people's access to sufficient nutritious food depends on their income. In Nigeria, poverty prevails and has reached a level at which the majority of the people are finding it difficult to eat (Olowonomi, 1997). Indeed about 60% of Nigerians are said to live below poverty line and most of them consume less than a third of the minimum required protein, because they cannot afford it. Thus, poverty can be said to the underpinning factor of the faulty protein nourishment in Nigeria today. In other words, Nigerians have no access to adequate income and therefore, cannot afford the protein of animal sources and even of vegetable sources such as cowpea, groundnut and soybeans because they are expensive. Consequently, the average diet of most Nigerians is dominated by cereal foods, resulting in the low rates of protein to carbohydrate intake by majority of the people in the country.

Thus, in Nigerian, the protein intake for the majority of the people is usually below the minimum required for normal healthy growth and development, for both children and adults, because of the high level of poverty in the country which has made access to nutritious foods impossible.

Effect of Protein Malnutrition

The mental and physical growth of children who exist in diet containing less than the minimum protein requirement is usually impaired (Darmman, 1979). In addition, lack of sufficient protein in quantity produces a liver disease, sometimes referred to as "sugar boy" and in Africa where it is prevalent, Kwashiorkor; meaning 'red boy as the skin and the hair pigment of the affected person become red coloured. Kwashiorkor, is the disease that is visibly associated with diet low in protein but adequate in calories. In adults, lack of protein also produces a feeling of fatigue and continuous protein deficiency causes a decrease in blood protein and liver damage (Fox and Cameron, 1968).

Significance of Single Cell Protein in Alleviating Insufficient Protein Sustenance in Nigeria

The most widely used novel protein foods in Nigerian today, are those derived from soybeans, of which the proteins are relatively of high biological value. Soya products are often made to simulate meat and intended as alternative source of protein to it. However, because of the high level of poverty in the country, the majority of people could hardly afford it (Taylor et al., 1997). A relatively new and cheap protein source is single cell protein (SCP). Its production began in the 1960s and the term refers to proteins obtained from the large scale growth of microorganisms, such as bacteria, yeasts, other fungi and algae for protein production. One of the important single cell protein product is Torula yeast, known scientifically as Torula Utilis, but recently renamed as Candida utilis. It is a yeast like fungi that has been used and is still being used as a food, hence it is known as food yeast or torula yeast. It belongs to the class of fungi known as deutromycetes; the family; cryptococaceae; and the genus; Candida. It is a saprophic fungus, ever present in air and grows profusely. Torula yeast is half protein (i.e 50%); the same protein content found in meat (Lucy, 1964). Thus its protein content is high and also of high biological value.

Torula yeast can be grown in factories. Indeed more than 40,000 million kg of torula protein are said to have been produced in a factory of 0.5 hectare of land piece. It has also been reported (hat 454.55 kg steer gives less than 0.46 kg of beef for every day of the month it takes to grow, and 500kg of soy beans seed produces 37.27kg of
soybeans meal for each day of the weeks that pass between planting and harvesting, which is more than any other crop could produce. Whereas, Torula yeast easily breaks these records, as 454.55kg of the yeast is said to reproduce itself so fast that it turns into 2727.27kg or 3181.82kg of protein in a single day and night factory production. Also in an experiment with improved production methods 454.55kg of torula yeast have been said to grow into 45454.55kg of protein in 24 hours {Lucy, 1964}.

Interestingly, also, while soybeans need land and fertilizer to grow, cattle, hogs, lambs and poultry need hundreds of pounds of feed, torula yeast is so greedy that it eats and grows on anything, as long as it contains sugar or starch. In other words, torula yeast can grow on useless things. For, instance, torula yeast has been known to grow on old rotten potatoes, water extracts from woods, molasses and on waste liquids that contain sugar or starch. Thus, obviously torula yeast makes protein of high biological value faster and more cheaply than other plants or animals.

Torula utilis or Torula yeast has been used for first and second world wars, and is still being grown for food purpose in some places. By the end of the second world, six factories in Germany that were making yeast with improved methods, produced about 1500,000kg of torula yeast that were eaten in the country in a single year. The British also produced the yeast on molasses during” the second world war for food in sugar plantations in British West Indies. In Trinidad, the patient in a leper colony who were suffering from malnutrition were said to have felt better when yeasts were added to their diet. Also prisoners who were in poor physical condition in the Royal Goal in Nigeria were reported to have improved when given the yeast diet, {Lucy,1964}.

Another important fungal source of single cell protein is fusarium graminearum which was originally isolated in the early 1960s from soil in Buckinghamshire. The product development of which started in 1964, and passed as safe for human consumption and launched in 1986, as the first commercial product of a savoury pie sold by J. Sainsbury." "Although originally used as an ingredient of manufactured foods such as pies and curries', Quorn as the product is called, became available for home cooking in 1990 and minced OUORN in 1992 and has been a commercial success {Taylor etal,1997}. The doubling time of the fungus, fusarium graminearum is 5.5 hours, which is slower than that of bacteria, and it uses glucose as carbon and energy sources which comes from cheap sources of starch, such as corn, wheat, rice potato or molasses, It produces 0.5Kg dry mass per kilogram of sugar used.

The commercial exploitation of single cell protein from bacteria, and algae and other fungi sources is under, active development as well. For example, certain bacteria are being grown on methane and methanol. Single cell algae have also been grown in tank wherever sunlight is abundant and they convert sunlight into protein and other foods with high efficiency. Another source of SCP under study is a strain of the fungi that produces penicillin, which grows on cheap carbohydrate substrates, such as potato, starch and molasses and converts them into a food rich in high quality protein {Taylor etal,1997}.

Although, as shown in table, a comparism of the amino acid pattern of SCP with beef shows that the former [I.e. SCP] is low in methione which is also limiting in soybean protein. The single cell protein [SCP] has the advantage of being able to grow on cheap media and also of very rapid growth. In addition, the final product of SCP has several health advantages than beef, in that it is cholesterol-free and has high fiber unlike meat. It is also a good source of vitamin 612 and zinc, which are often lacking in the diet of vegetarians.

Table 1: Essential Amino Acid Content of Novel Proteins {Mg/G Protein} Compared With Beef

<table>
<thead>
<tr>
<th>Amino acids</th>
<th>Be</th>
<th>Soyabean</th>
<th>Grass</th>
<th>Yeast</th>
<th>Fungi</th>
<th>Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoleucine</td>
<td>53</td>
<td>62</td>
<td>93</td>
<td>45</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Leucine</td>
<td>82</td>
<td>79</td>
<td>130</td>
<td>70</td>
<td>55</td>
<td>68</td>
</tr>
<tr>
<td>Lysine</td>
<td>87</td>
<td>53</td>
<td>72</td>
<td>70</td>
<td>51</td>
<td>59</td>
</tr>
<tr>
<td>Methionine</td>
<td>38</td>
<td>16</td>
<td>21</td>
<td>18</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>75</td>
<td>49</td>
<td>93</td>
<td>44</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Threonine</td>
<td>43</td>
<td>37</td>
<td>67</td>
<td>49</td>
<td>25</td>
<td>46</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>12</td>
<td>11</td>
<td>21</td>
<td>14</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>Valine</td>
<td>55</td>
<td>53</td>
<td>103</td>
<td>54</td>
<td>60</td>
<td>56</td>
</tr>
</tbody>
</table>

Source: John WK (11975); Man and Nature: Environmental Biology

Conclusion

In Nigeria today, cereals are the main course of food at every house meal due to high level of poverty that has made access to nutritious foods impossible for not less than 60% of Nigerians. In effect, nutrient deficiency disease, particularly diseases resulting from insufficient protein sustenance have become prevalent national diseases of serious concern in the country. Obviously, the development of a cheap food concentrate of high protein content, is one important way of solving the protein problem. SCP has a high protein content, of high biological value and makes protein faster and more cheaply than any other plant or animal, and therefore, constitutes a significant raw material for cereal food fortification as a means of insufficient problem alleviation in Nigeria.
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