ACID-BASE CONTENTS OF EDIBLE FOOD SAMPLES: FOCUS ON INQUIRY-DISCOVERY SCIENCE LEARNING F0R QUALITATVE AND FUNCTIONAL EDUCATION

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Abstract

This paper examines the necessity of teaching and learning science as a process of inquiry-discovery against the background of significant breakthroughs which over the centuries had been made by eminent scientists for man's benefits through the process of inquiry and discovery. Using some edible food samples in our environment, the paper shows how the acid-base contents in the samples can be probed into and by so doing inculcate in the learners the scientific attitudes of inquiry and discovery that can stimulate scientific thoughts and lead to breakthroughs. Science taught and learnt in this way is indeed qualitative and functional as breakthroughs arising from such knowledge are bound to serve the needs of the society. To achieve this, the paper recommends adequate provisions of laboratory equipment and facilities for meaningful inquiry and discovery.

Introduction

One of the seven points in the agenda of President Yar'adua-Jonathan administration is to ensure quality and functional education. This is education where excellence in both teaching and learning the skills in science and technology are ensured. The overall aim of such education is to produce scientifically and technologically literate students who will be seen as future innovators and industrialists in the country. Science, as we know, is a systematic study of nature. It has, as its components, the product and the process dimensions .The product of science deals with the facts, ideas, principles, generalizations and concepts. The process component, on the other hand, has to do with skills such as observation, classification, communication, measurement, inferring, hypothesizing, predicting, analyzing, drawing and application which must be acquired and developed for use to arrive at the product of science. According to Agbo (2000), skills are expertness, practical ability, dexterity and facility in doing something. They could also mean knowing how to use a procedure (Johnson and Wham, 1980). Process skills help the scientists to find answers to problems. Although many instructional strategies (e.g. analogy approach, concept mapping) could be used to acquire scientific knowledge, teaching and learning science as an inquiry-discovery undoubtedly encourage the development and acquisition of the process skills of science. Little wonder why the American Association for Advancement of Science (AAAS, 1965) stressed the need to teach science as a procedure of inquiry since science is more than a body of facts or collection of principles.

It is also a well known fact that learning becomes most effective when relationships between and among variables are discovered and generalizations unfold through a planned sequence of inquiry experiences rather than through being copied or memorized.

The importance of using the process skills of inquiry/discovery approach in science teaching and learning is that even when the instruction or learning is over, the processes still remain after the many details of the contents had been forgotten(AAAS, 1965). The process skills indeed are characterized by actions and personal involvement with problems and equipment. The emphasis of Jerome Bruner, the proponent of learning by inquiry/discovery, is on the production of and manipulation of materials through what he calls enactive, iconic and symbolic stages (Ogunniyi, 1983). Literatures are replete with prominent scientists who produced and manipulated learning materials through a roller-coaster ride of successive equilibria and disequilibria until breakthroughs were attained. For instance, Benjamin Franklin who is associated with the invention of the thunder protector toyed with electric wires/plates connected to a flown kite in the sky. Though, he died in the process during a downpour with an electric spark and thunderstorms, his experience of inquiry/discovery lives on to this day. Similarly, before the mystery of the structure of DNA as a double helix was finally solved and published by Watson and Crick in a prestigious science journal called Nature, many ups and downs of inquiry/discovery were passed through (Matthews, 1993).

Equally true, the wave-particle duality of matter and radiations came to lime-light after progressive failures and successes of inquires and discoveries by eminent scientists including Isaac Newton, Albert Einstein, Arthur Compton and Thomson Young (Matthews, 1993).

Furthermore, the mystery behind the cause of AIDS that is now ravaging humanity began to unfold in 1981 as a result of the detective/inquiry works of New York and Los Angeles medical doctors on the curious increase in numbers of previously healthy young men with a rare form of pneumonia (Pneumonia carinii) and a rare form of cancer on the connective tissue (Kaposi sarcoma). When finally in 1983 HIV was isolated by Luc Montagnier and colleages in France and linked to the causes of AIDS (Matthews, 1993), the entire process progressed through scientific inquiry/discovery. Also, the identification of protons by Ernest Rutherford and neutrons by James Chadwick as the nuclear components of an atom surrounded by electrons, occurred by a steady yet rough progressive process of scientific inquiry and discovery.

It is against the backdrop of the fore-going significant breakthroughs in science via the application of the inquiry-discovery method of learning that this paper seeks to apply the approach to the study of selected edible food samples in our environment in order to illustrate how elementary science students could be made to study/learn science as an inquiry/discovery process. The overall purpose is to show how to inculcate in the students the science process skills necessary for qualitative and functional education that will stimulate national growth and development.

Experimental Procedure

Samples of edible food samples were employed to illustrate the concept. They included lime fruits, lemon fruits, grape fruits, unripe oranges, tomatoes, English apples, water melons, coconut fruit, garden eggs, sour cow milk, gruel(or kunu in local parlance) and Acorn species (or zobo in local parlance). All the samples were obtained from Zaria LGA of Kaduna state. The juice from these fruit samples was extracted by means of a grater and simple centrifuge. The juice so extracted was filtered and kept in labeled test tubes. From the coconut sample, its water (cell sap) was obtained and kept in test tube while the fruit was crushed and the juice extracted and kept also in a test tube. The cow milk obtained from a cow rearer was fermented for 3days and used as soured milk sample (or fura in local parlance). This also was kept in a test tube. The Acorn species (zobo) was soaked in water for 10minutes to extract its pigments while a freshly prepared gruel (kunu) sample was obtained from the dealers. The 'zobo' extract and the 'kunu' were kept in labeled test tubes. The readers may use extracts from available fruits/edible foods in their locality. These samples were subjected to laboratory tests and analyses using universal indicator and litmus papers/solution.

Experimental Analysis

To determine the acid or base contents or otherwise of the samples, about 10ml of each of the samples in the labeled test tubes was tapped and treated with about 2ml of the prepared universal indicator solution. A colour variation was observed and this was compared with the standard colour variation of universal indicator to determine the pH match for the samples. The samples were subsequently tested with blue and red litmus papers/solution to affirm their acidity, alkalinity or otherwise. All the various samples were tested in this way and the results are presented in Table1 as shown:

Results

Table I

Behaviour of samples with universal indicator and litmus.

Food Sample	Color variation observed with universal indicator	pH range matching with observed color	Action on litmus
Lime	Orange	2.00 - 4.50	Red
Lemon	Orange	2.00 - 4.50	Red
Grape	Orange	2.00 - 4.50	Red
Orange(ripe)	Red	0.00 - 2.00	Red
Orange(unripe)	Orange	2.00 - 4.50	Red
Tomatoes	Yellow	4.50 - 6.50	Red
English apples	Yellow	4.50 - 6.50	Red
Coconut water	Green	6.50 - 8.00	Neutral
Coconut fruit	Yellow	4.50 - 6.50	Red
Water Melon	Yellow	4.50 - 6.50	Red
Garden eggs	Green	6.50 - 8.00	Neutral
Sour milk(fura)	Orange	2.00 - 4.50	Red
Gruel (kunu)	Red	0.00 - 2.00	Red
Acorn sp(zobo)	Red	0.00 - 2.00	Red

Discussion

A universal indicator is made up of a mixture of various indicators which work at various pH ranges (Ababio, 2004). It can be used to determine the approximate pH of a solution to about ±1 unit (STAN, 1988). The colour observed for a given solution using the universal indicator is usually matched or compared to a colour chart with a pH calibration. From such matching or comparison, the pH of the solution is determined. Although the pH so determined is approximate, it gives an insight into the level of alkalinity or acidity of that solution. From the experimental study in this paper, it can be seen that majority of the food samples used are acidic (as shown by their pH values of less than 7) except garden eggs and coconut water where pH value is about 7. The litmus test further confirmed the behaviour of the samples - the acidic ones turning blue litmus red while the neutral samples produce no change on litmus.

Conclusion

Having obtained the approximate pH values of the solutions, an inquisitive learner would ask questions as to how to measure the exact pH of the solutions or what acids are actually present in the solutions and why the other solutions were neutral. He might also want to know what causes the colour of the solution samples to vary between orange or yellow or green or red with the universal indicator or what could be the consequence on the human body of consuming the food samples with such acidic contents. Such questions bothering on the “why”, “how” and “what” of things and happenings constitute the essence of science (Besmart-Digbori, 2008). Attempts to answer these “why”, “how” and “what” questions are likely to provoke inquiry that might result in discovery. An inquiry into the acid contents of plants and animals of various kinds and their discovery can ginger further scientific investigations into their identifications and isolation for specific purposes that can be of immense value to mankind. Learning and teaching science as an inquiry and discovery will undoubtedly make science learning relevant and functional to the needs of the society and as well promote national development.

Recommendations

For science to be studied effectively as an inquiry-discovery process, the following recommendations are made:

(1) Science equipment and facilities should be provided in science classrooms/laboratories. For instance, to ascertain the exact and accurate pH values of the solution samples used in this work, more sophisticated equipment such as the pH meter can be applied

(2) Students who have no knowledge of sophisticated equipment such as the pH meters should be stimulated first to think and explore ways of measuring accurately the pH of the solutions of the samples. This is bound to stir up the spirit of inquiry and discovery among the students.

(3) More extracts of plant and animal origins should be included in this work for students using the universal indicators and litmus and subsequently pH meters.

(4) Also, the design and working of the pH meter should be made known to the students to stimulate their curiosities and scientific attitudes of inquiry for discovery.

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