COMPUTER ASSITED LEARNING ON STAGES OF FERMENTATION

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CERTIFICATION

We certify that this work was carried out by Imienwanrin Marcel Ross in the Department of Math/Computer, Federal University of Technology, Minna

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DEDICATION

This work is dedicate to all those who are working recentlessly to develop new scientific
to take man to his rightful technological heaven and to God, the Almighty scientist.

ACKNOWLEDGMENT

I am greatly indebted to my supervisor Dr. Aiyesimi Yomi whose wonderful and recentless ervision made this work a big success. Also to my wife Aina Ross who encouraged me ughout this project.

I express my thanks to my friends Mr. S. Akpan, Mr. Kehinde M., Mr. Sam Goshie for constructive critism and advice.

I must express my special thanks to member of my family who have been my motivating r by way of advice.

I am sincerely greatful to the HOD Math/Comp Dr. Adegboye members of staff Maths/ puter and all my collegues during this Diploma programme.

My chain of thanks will be insignificant if I fail to mention my Mentor Hussaini Anthony un who planted the seed to pursue this programme in my heart.

Finaly I thank the Almighty God who spare my life, gave me the strength and courage to e this programme.

God bless you all.

MARCEL ROSS

1998

TABLE OF CONTENTS

CHAPTER ONE

1.0 GENERAL INTRODUCTION

1.1 INTRODUCTION

This project is aimed at teaching the process of fermentation using computer.

The attention of the world is being diverted from manual operations into computer assisted operations. This has contributed in making things easier and faster, as well as improve fast understanding of concepts, processes and mechanisms. This application is glaring in the field of Engineering and Technology, Medicine, Banking etc.

Apart from the fields mentioned above, the computer train has also, penetrated into the field of learning via teaching.

It is becoming less convenient for people to learn by attending classroom lectures tutored by teachers, rather what is now gaining ground is the idea of people, buying a diskette, containing prepared information about their interest, slot it into a computer and stay behind to watch these prepared information being dole out to them at their own convenience and the comfort of their houses.

This project is in line with the above tide, that is to assist the learning of fermentation processes using computer.

1.2 DEFINITION OF FERMENTATION

Fermentation is an ATP generating metabolic process in which organic compound serve both as election donor or electron acceptor. The compound that perform this two functions are usually two different metabolites derived from a single fermentable substrate such as sugar.

Simply put fermentation is the anaerobic break down of sugar to release alcohol.

1.4 CONCEPT OF FERMENTATION

The concept of fermentation is to strike a strict balance between oxidation and reduction.

Pyridine nucleoside is reduced in one step of the process and them oxidized in another step of the process. The product formed depends on the ability to strike a balance between oxidation and reduction.

1.5 OBJECTIVE OF FERMENTATION

The objectives of fermentation is to use microorganism like yeast to convert organic substrate like sugar into fermented products like alcohols etc.

SCOPE OF STUDY

This project is aimed at looking at the following areas of fermentation for proper understanding of the process.

I) Fermentation media

ii) Type of fermentation media

(a) Simple media

(b) Complex media

iii) Buffering of media

iv) Media economics

v) Stages/step in the process of fermentation using the following examples: alcoholic fermentation.

vi) Examples of application of alcoholic fermentation.

CHAPTER TWO

LITERATURE REVIEW

The study of the process of fermentation has engaged scientist for a long time. Notable among early workers are:-

Schwann, Liezbig, Wohler, Cagniardlatonr, Pasteur and Berzelius.

For a very long time the principle of fermentation was not clear. There was two school of thought, namely the vitalistic and mechanistic.

The vitalistic approach is that there is a vital force outside the cell that controls fermentation.

The mechanistic school of thought was that fermentation is control by chemical events in cell.

Pasteur, a microbiologist and a biochemist, define fermentation as the consequences of life without air (anaerobic condition). But the true nature and reaction mechanism of fermentation was discovered by chance in the late 19th century.

Butcher et al extracted portion of yeast but found that the extract reacted with sucrose which was introduced into the medium as preservative this discovery is said to have given birth to modern biochemistry. This reaction showed that part of living system could be made to react with pure compound in vitro.

Edward Butcher was able to establish that alcoholic fermentation was mediated by a yeast enzyme, thus he was the first to demonstrate enzyme mediated fermentation reaction.

He named the yeast enzyme zymase, but it is now known that the enzyme is not a single enzyme but a series of enzymes which make up the embdem meyerhoff pathway for sugar catabolism. It is also known that this enzyme are not extracellular but within the yeast cells and this defeat the theory of vitalism.

The underline unity among microorganism was established by K/uyuer in 1924 when he observed that by adjusting such parameters as growth medium or culture conditions, one could change the types of metabolic intermediates or end products. Which accumulate during the growth of various microorganism. His study allow a more rational approach to the study of microbial physiology and led to the understanding that they could be manipulated to yield desire products of economic values.

STAGES OF FERMENTATION

MEDIA OF FERMENTATION

The choice of fermentation media is as importation to the success of industrial fermentation as it Isolate and maintain organism to carry out fermentation.

The medium supply nutrient for the growth of fermenting organisms, which intern supply the enzymes for fermentation. The medium also supply amino acids, antibiotic, vitamin etc of particular importance are sources of carbon, nitrogen, phosphorus.

The media also contain growth factors like inorganic acid and certain precursors of fermentation eg pectin for pectinic enzyme.

A poor joice of media component can result in limited growth of fermenting organisms and thus affect the yield of products.

For designing a medium, the general concept to be followed include

i) Adequate concentration of all elements must be provided in to medium to produce cells of expected composition, so as to give the required product yield.

ii) The medium should contain specific nutritional requirement such as purines, pyrimidines, Amino acid and water soluble vitamins.

lii) Sufficient amount of energy source and this will be base on the yield constant.

$$\text{Yield constant} = \frac{\text{g of cell}}{\text{g of substrate}}$$

TYPES OF FERMENTATION MEDIUM

There are two main type of fermentation media: simple and complex media.

Simple Media:- They are made up of inorganic acids or organic salts or Nitrogen salts and use in addition to sunlight. They are use for autotrophic bacteria.

Complex Media:- There two groups of complex media:- synthetic and crude media.

In the synthetic medium, the constituent is known, so the media is well define e.g the medium by Rolze and Canberra (1980) where we have:-

(NH4)2 804	20.75g
Mg 840	1.59g
H3 PO3	3g
Sugar (glucose/fructose)	2%

This is made up to 1 litre.

Synthetic medium has the following advantages:-

i) the amount of any one component or several components can easily be verified to determine its specific effects on cell growth and product yield.

Ii) The recovery and purification of fermentation product are relatively simple because extraneous compound are not included and the compound which interfere are known.

Iii) It aid reproductively of the organism and product.

In the crude media, their constituents are not well defined, they can be made from Soya bean meal, molases (water materials from sugar), sulfite liquor (by product of pulp paper industry), corn steep liquor (in both corn oil and corn starch industry) yeast extract etc.

The crude media are cheaper. Some crude media include

(I) molases:– It is a by product of sugar industry and they are called serup recover at one or the several steps, and the stage at which its is obtain is use to name it. Black serup molases is the cheapest obtained during the cooking processes and is mainly use during industrial fermentation. Other factors are added to the medium.

ii) **Corn steep liquor:-** It is often use in feeds and antibiotic especially penicillin. Corn steep medium normally obtain from steeping corn in corn oil or starch industry. Corn steep medium can be in liquid, semi solid or solid medium. Other important growth factors are added .

Buffering of Media

During fermentation, the PH changes occur for one or several reasons, it could be due to acid production, decarboxylation of organic acid and deamination of organic Amine.

Buffering the media is very important as it bring the PH of fermentation to about neutrality which favour the process of fermentation. The protein in the medium ofter good buffering compound. Though some compounds like KH P04, Na_2HPO_3, KH_2PO_2, NaH_2PO_2 can be also use to buffer a medium.

MEDIA ECONOMICS

This is important because the cost associated with the production media can form a large part of the total cost of production. Media contain high concentration of sugars, and Nitrogen sources. Because these materials are usually expensive call for rationalization of acquiring them. Hence cheap sources are usually employed.

These media materials are usually by products of agricultural production. The cost of getting may fluctuate in demand and supply as well as the industry that use these materials as raw materials for production.

If there are several media, the medium that allow for rapid growth and high cell yield are best for production of fermentation medium. However there are certain industrial process where restricted cell growth is good for fermentation, this is because greater amount of substrate are fermented into products instead of for cell growth eg is cephalosporum sp in the production of cephalosporum has a restricted growth in molases medium.

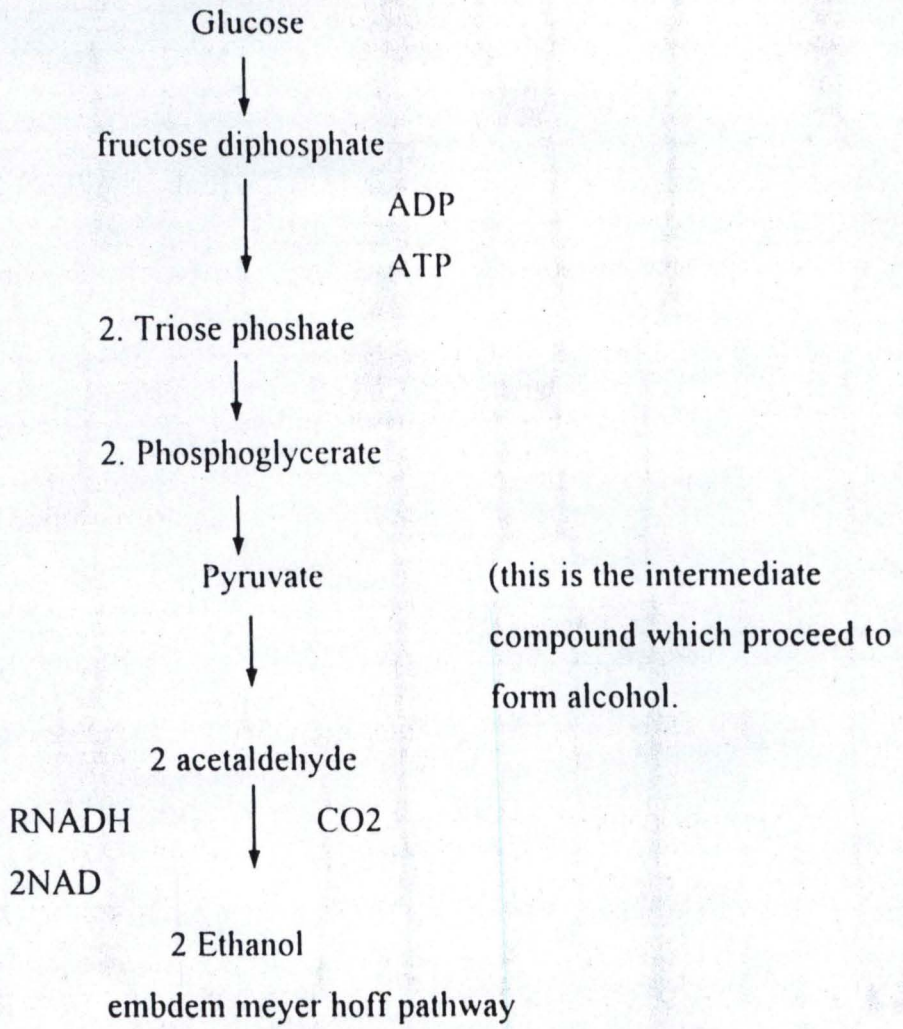
We should use the media that will give us a high yield return.

STAGES IN THE PROCESS OF FERMENTATION

ALCOHOLIC FERMENTATION

The embdem meyer hoff pathway is the most wide spread mechanism for the Fermentative conversion of glucose to pyrovic acid (pyruvate)

This pathway is shown blow



embdem meyer hoff pathway

This pathway is a simplified pathway of the stages of fermentation, other fermentation stage like lactic acid fermentation, butyric acid fermentation follow a similar partern.

CHAPTER THREE

3.0 SYSTEM ANALYSIS AND DESIGN

3.1 DEFINITION OF SYSTEM ANALYSIS

System Analysis is the process or activities involved in examining an already existing system (manual or computerized system) for new system to be introduced. The persons whom are involved in carrying out these task are called the System Analyst and their primary aim is to obtain complete and reliable information that will help the analyst with the knowledge of prevailing situation so that the feasibility of designing as effective new system can be known.

However, system Analysis then become very necessary when there is the need to ascertain the best method to use the computer with its related equipment and resources to perform necessary task which will meet information need of an organization.

3.1.2 STAGES OF SYSTEM ANALYSIS & DESIGN

System Analysis consist of series if activities and chronological procedures which are conveniently discussed below:-

1. PRELIMINARY SURVEY

This is carry out to ascertain if there is the need for a new system and to identify its objectives. This process is carried out by steering committee set up by the Management of the organization to be computerised. The committee will also oversee the project to ensure that the aim and objective of the project are achieved.

2. FEASIBILITY STUDY

Feasibility Study is the broad study of a system to identify reasons which justifies the development of the new system or favours non-execution of the project. The following factors are mainly considered:-

(a) cost implication

(b) suggest solution to the problem

(c) technical implication

(d) economic implication

(e) political implication

Having successfully completed the above five (5) process, a feasibility study report is presented to the management of the organisation. If the report favours project execution, the next stage is commenced , but if the report did not favours project execution, the project terminates at this stage.

3. FACT FINDING

Fact finding is carrying out detailed study of an existing system to completely identify the problems and information requirement of the existing system.

4 FACT ANALYSIS

Fact Analysis state is a stage where critical examination of all recorded fact is done with a view of having proper assessment of the current system. This stage provide necessary information with which the design of a new system can commence.

5 SYSTEM DESIGN

System design is the use of an analyst creative idea or ability and sense in organizing a logical and meaningful but literally feasible procedure for a computerised system.

6. SYSTEM IMPLEMENTATION

This involves the coordination of all the task which are necessary in ensuring the operation of the new system

Specifically, system implementation comprises of 2 major task namely:- programming and staff training.

7. SYSTEM REVIEW & MAINTENANCE

This involve examining and modifying the new system (as may be required due to changes in organisation requirement) for a period of time to ensure that the set objective are achieved and new improvement inculcated.

8. SYSTEM DOCUMENTATION

This is the preparation of a user guide or manual which shows detailed recording of all the activities involved in designing and implementing the new system.

3.2 THE PROPOSED SYSTEM & ITS RELEVANCE

The proposed system is going to be a computer Assisted learning (CAL) program on stages of fermentation.

Actively, the relevance of the proposed system (CAL) will include:-

1. To serve as a learning tutor to novice of stages of fermentation.

2. To propagate and increase the design of an indigenous computer Assisted Learning (CAL) in the country,

3. To increase the familiarization and the use of the computer system.

3.3.1 ARTIFICIAL INTELLIGENCE

The first four generation of computers have been based on advances in technology, valves, transistors integrated circuits, and microprocessor. The fifth generation computer will still probably be based on silicon chips, but they will be much more powerful than any contemporary computers and will have some reasoning powers. In the earlier so's, the Japanese promised to launch a 10 years programme towards advancement, thus we are yet to know the out come, but speculation, are that the system, are going to posses serious reasoning powers like the artificial intelligence.

WHAT IS AN INTELLIGENCE

An intelligence implies to choose and form an opinion, a choice among and understanding of phenomenou beyond ordinary.

Indeed human intelligence is exhibited in man's action, responses and choices are designed to do the same or beyond by setting path such as structure to structure and others than machine can do beyond the reach of man because of the machine affirmative ability to keep track of events ie backward or forward than man.

However, when machine exhibits human intelligence, it is known as machine intelligence and machine being man-made thus artificial, machine intelligence is called ARTIFICIAL INTELLIGENCE, while human intelligence is called NATURAL INTELLIGENCE.

3.3.2 FIELDS OF ARTIFICIAL INTELLIGENCE

Since Artificial Intelligence is concerned with the creation of computer program that do things that require intelligence, it can therefore be said that artificial means programming a computer to perform activities that if done by a person would be thought to require intelligence. Because of the above definition, the areas of fields of artificial intelligence includes:-

1. NATURAL LANGUAGE PROCESSING

This means the programming of computer to understand language. Using English for example, a bank customer would respond with the proper amount.

However, the problem with Natural Language Processing Systems is that English can be unclear. For example, if a traveler asked a natural language system what is the temperature of Kano? The computer would have to know whether the traveler meant Kano State or Kano City.

2. ROBOTICS

Robotics can be programmed to handle specialized tasks, such as cutting, drilling, painting and welding, they are particularly good at performing the same motions again and again day after day. They can also be used to perform dangerous or difficult tasks that human prefer to do. However, newer robots incorporate a certain amount of vision perception, and thus are able to perform assembly tasks of increasing complexity. Industrial robots are very expensive, but they are becoming economically viable for wider range of tasks as their capabilities are extended.

3. PERCEPTIVE SYSTEM (MACHINE VISION)

This has been used to improve the capabilities of robots. For instances, robot with machine vision in an electronic assembly plant can take a snapshot of the circuit board being worked on and then insert components in the proper place.

4. EXPERT SYSTEM

Expert System which can also be known as intelligence knowledge based system are being developed to solve a range of practical, problems. As with 5th generation computer, they represent a departure from, in particular, traditional methods of programming. Expert System has been defined as (quoted by D' Agape yeff, 1983)

"They are problem – solving programs that solve substantial problems generally consider as being difficult and requiring expertise".

Moreover, they are called KNOWLEDGE BASED because their performance depends critically on the use of facts and logistics used by experts.

3.4.1 EXPERT SYSTEM VS COMPUTER ASSISTED LEARNING

Since expert system is a problem – solving programs that solve substantial problems generally consider as being difficult and requiring expertise, it then follows that they are mostly employed in scientific or experimental use, but today there is a clear shift towards the commercial environment and towards practical applications in such area as education and medicine.

Computer Assisted Learning on the other hand is also a knowledge based program, it is a fraction of an expert system, thus there are no basis for comparism, but an expert

System posses all the characteristical features of a computer assisted learning (CAL) even though a CAL might not really posses the complete feature of an expert system because of the complexity of an expert system. However, in most cases a CAL is always a tutorial program that teaches some specific topic of a subject of interest mostly developed by software houses.

3.4.2 COMPONENT OF AN EXPERT SYSTEMS

(a) KNOWLEDGE BASE

The Knowledge Base comprises of a series of facts and rules. It stores not only very large quantities of information, and rules relating various items. A knowledge base has a much more complicated structure than the largest databases in use at present, and requires very sophisticated accessing mechanism.

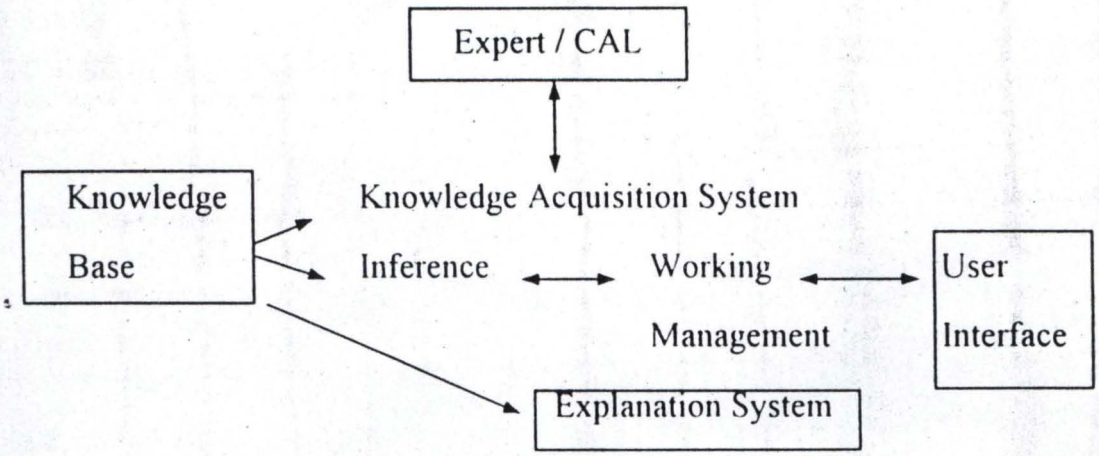
(b) AN INFERENCE ENGINE

This component is able to draw reasoned conclusions from the information and rules of association in the knowledge base. It will be able to resolve any doubts or inconsistencies in the knowledge base, make reasonable and educated guesses and demonstrate its line of reasoning if required.

(c) THE USER INTERFACE

The overall purpose of the user interface is to make the development and use of an expert system easier for users and decision makers.

Specialized user interface software is used for designing, creating, updating and using expert system to day. The user to develop and use their own expert system (CAL).



3.4.3 FEATURES OF A COMPUTER ASSISTED LEARNING (CAL)

For any CAL to be successfully implemented and used, it is necessary that the system performs at least almost as well as the human tutor in the field, since if it is does not, then the systems effort does not worth it. It will obviously be describe to have the CAL perform better than the human tutors. The CAL can only achieve these through the followings:-

1. **SIMPLICITY**

The CAL should be simple to understand with an in depth explanation.

2. **SUBJCET TO REASONABLE TIME RESPONSE**

If the CAL takes an unreasonable time between the period of asking a question and answer, then the CAL will not be used, and the end users will not be encourage as time is always precious to novice of computers.

3. **SUBJECT TO MODIFICATION**

Human tutors is changing all the time. New facts, techniques and research are being carried out often and often, and various method devised, just like new test and rules come into existence.

The CAL on the stages of fermentation is also not left out modification, any new discoveries can always be updated as the source program is always available.

Hence, a computer assisted learning (CAL) can also be subjected to changes with a similar level of flexibility as human tutors in modifying its knowledge base.

4. AN ACTIVE USER INTERFACE

For any CAL to be well accepted by it users, it has to posses an active user interface, with user friendly and easy menu driven. CAL expertise, has shown that no matter how brilliant, simple and user friendly a CAL tutor is, if the social aspects of the CAL (both on a personal level as if found in the user interface and on an organizational level where fermentation are mostly going to be used) are not dealth with properly, the CAL will not be popular and fully accepted by the end users.

However, this facts has often been over looked with some authors agueing that:-

"The quality of the knowledge base is the ultimate determinant of the usefulness and effectiveness of the application" (Buoyant, 1988). This shows that a brilliant knowledge base with a poor user interface will not be used, whilst a small knowledge base with a good interface may be very useful.

3.5 CHOICE OF PROGRAMMING LANGUAGE

The earliest computer assisted learning and expert system program were developed in symbolic programming languages. These languages are structured to facilitate the processing of symbols rather than the processing of numbers. For example, a symbolic program can be written to more trigonometric identities ($\sin^2 x + \cos^2 x = 1$) or to solve fundamental integration problems in calculus. In addition to such formal logic

Problem, these languages can be used to write a computer assisted learning problem and that of an expert system.

However, while there are many symbolic languages, two have gain most prominence. LISP (for list processor) was developed in early 1960's by John Mc Carthy, one of the pioneers of artificial intelligence (A.I.). One major strength of this language is that programs and data are structured in the same way. This means that one LISP program can be written to accept another LISP program as data. Thus one program can be written to change another. Infact, a LISP Program can accept itself as data and modify itself while it is in executive. The chief disadvantage of LIPS Program is that they are hard to understand.

Furthermore, PROLOG is the second language that has received wide spread used for symbolic programming. It was developed about 1970 by Alain Colemeraner at the University of Marseilles. It enjoys wide popularity worldwide.

This shows that, developing expert system or CAL is a symbolic programming language requires expertise of sophisticated (and expensive) computer scientists. It is also very slow, labour intensive and expensive. Therefore, these languages were not normally use for the development of an expert system in the commercial world and hence, the preference for conventional programming language are very slim as there are more and more database programming language especially with the advent of the 5th generation languages that prove simple and user friendly.

To this end, because of the deficiencies of the aforementioned programming

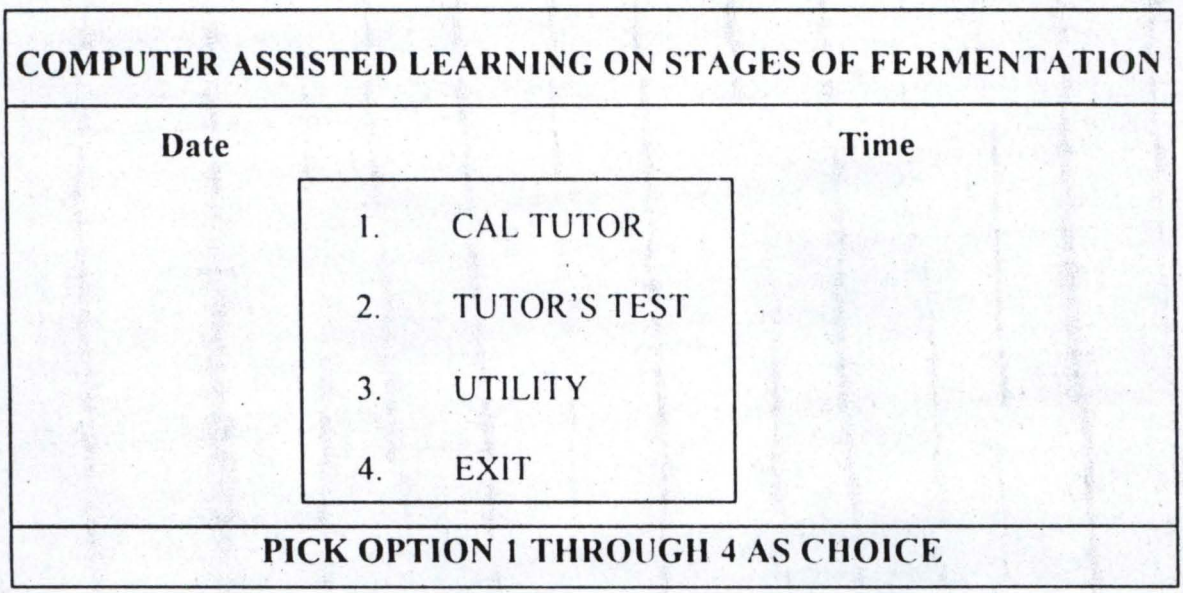
Language, Dbase IV and Clipper 2.0 is chosen as the choice of the programming language because of the following reasons:-

1. With Dbase IV and Clipper 2.0, it is easier to develop a user friendly application, hence data entry and updating can be easily performed where it is necessary.
2. It is suitable and easy to understand.
3. Data Integration is achieved.
4. Data redundancy is reduced or eliminated.
5. Data integrity can be maintained are centrally controlled.
6. Lastly, with the clipper 2.0, the program can be compile to executable file thereby enabling the software to run from Dos prompt independence of the application software used in writing it.

3.6 DESIGN OF THE PROPOSED CAL ON STAGES OF FERMENTATION

Fermentation process involve certain stages, this stages are broken down using the method of top-down approach (i.e method of braking down complex problem with manageable modules or procedures. Each module is required to perform a specific task. This has the advantage of allowing for quick means of program debugging.

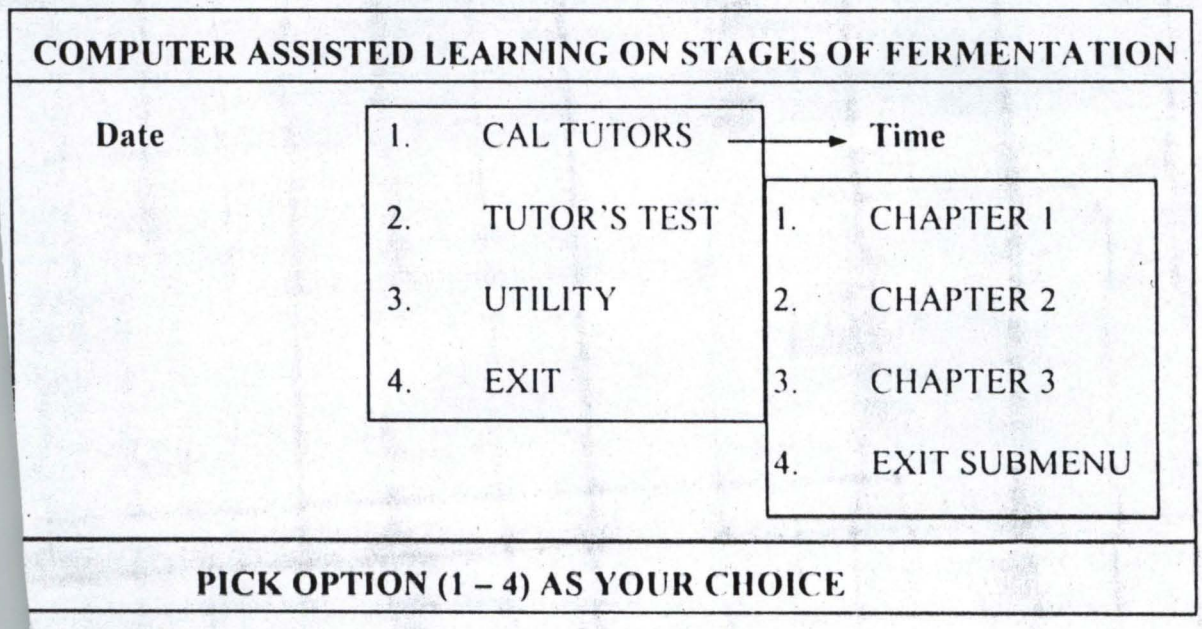
Because of this reason, the design of the proposed CAL on stages of fermentation has a main menu system based on the stages involves in the fermentation process. Below is the format of the main menu of system.



The proposal uses numeric number as option for activating a desire choice. This option is within the rang of (1 - 4).

1. CAL TUTOR

This option contain the knowledge base of the Computer Assisted Learning Program. On processing {1}, it displayed another submenu that gives chapter 1, chapter 2, Chapter 3 and Exit Submenu. The structure of CAL TUTOR is as shown below:-



However, the stages of fermentation have been program to be contained in three (3) chapters as shown above with each chapter having detail information of fermentation process. Starting with Historical Background of Fermentation. Fermentation media, definition of fermentation, Alcoholic Fermentation etc.

2. TUTOR'S TEST

Having fully run the CAL TUTOR from chapter to chapters, option (2) i.e TUTOR'S TEST provide brain storming test for the end-user to attest whether the user understand what they have gone through in option (4) of the CAL Program.

However, here mark are awarded for each correct answers and at the end of the test, total mark scored is displayed as against the user name.

3. UTILITY

This is the third option of the main menu, it allow the copying and Restoration of text file, if in case there is any modification as a result of improvement on scientific experiment, tests and changes in rules.

4. EXIT

This is the last option of the CAL, on pressing (1), it clear the computer screen, close all activated database and text file in use at that point in time and then return to Dos prompt.

3.7.1 DATABASE FILE USED

The proposed CAL Program will work with three(3) database file, that is the password database file, the answers database file and the candidate database file.

PASSWORD DBF

Then database file contain records of users together with their passwords.

S/NO.	FIELD NAME	TYPE	WIDTH
1.	USERCODE	CHR	5
2.	USENAME	CHR	30
3.	PASSWORD	CHR	7

ANSWERS. DBF

This database file is used to hold all the answers to the tutor's test question as contain in the program procedures. The structure of the database file is as shown below.

S/NO	FIELDNAME	TYPE	WIDTH
1.	Q NUMBER	NUM	2
2.	ANSWER	C	1

CANDIDATE. DBF

This database file store information regarding candidate that use the TUTOR'S TEST. The structure of the database file is shown below.

S/NO.	FIELDNAME	TYPE	WIDTH
1.	NAME	CHR	30
2.	MARKSCORE	NUM	2

3.7.2 TEXT FILE USED

Text files are files that often posses TXT as there file extension and in most cases they contain ASCII characters and are at times called the Reader file because of the fact that they stored information pertaining to the software in use which can easily be open under the Dos-environment by the use of the Editor Command Line.

However, here text file are used in this CAL to served as a knowledge base program that hold all the information regarding stages of fermentation process. Three (3) text files are use throughout in this program and each of the text file is a procedural program that can be activated by pressing the desired option (i.e Chapter 1. TXT, or Chapter 2. TXT or Chnapter 3. TXT.

CHAPTER FOUR

4.0 GENERAL IMPLEMENTATION

4.1 CAL IMPLEMENTATION

Implementation in the literal meaning is into something into operation. Here, the Computer Assisted Learning (CAL) Implementation involves all the activities which are necessary in ensuring the operation of the new system.

CAL Implementation comprises of two (2) major stages namely:-

1. **PROGRAMMING**

Programming which is the act of setting up well defined and constructed instructions which direct the activities of the computer system. The CAL Program is written to served as a field tutor that teaches and make users literate about the stages of fermentation.

2. **TRAINING**

Another area of CAL Implementation is the training. Training becomes very necessary if the CAL is going to be used in an industry where the users are completely novice of how to operate the Computer System. Since CAL has been designed to have active user interface, that simply implies that, it is going to be easy to use and user friendly.

4.2 HARDWARE & SOFTWARE REQUIREMENT

For proper implementation of the designed CAL, certain Hardware and Software are essentially required for this aim to be achieved.

HARDWARE REQUIREMENT

Hardware which simply mean all the physical component of a Computer System including its accessories. The following hardware and accessories are needed for maximum utilization and implementation of the CAL on stage of fermentation and also for other uses.

S/NO	HARDWARE REQUIREMENT
1.	COMPLETE COMPUTER SYSTEM
	▶PROCESSOR ⟶ PENTIUM333MHZ CELERON INTEL
	▶HDD CAPACITY ⟶ 4.1 GB
	▶MEMORY ⟶ 32MB RAM
	▶KEYBOARD ⟶ WINDOW'95 KEBOARD
	▶MOUSE ⟶ MICROSOFT KEYBOARD
	▶DRIVES ⟶ 3.1 "FDD. 5¼" FDD CD-ROM DRIVE
2.	▶UN-INTERRUPTED ⟶ POWER SUPPLY (UPS)
3.	AUTOMATIC VOLTAGE REGULATOR (AVR)

SOFTWARE REQUIREMENT

Software are set of instruction arranged in a meaningful manner which instruct the computer on the procedure involved in accomplishing a particular function or task. Software are sub-divided into its functional capabilities which include System Software and Application Software . System software is the most vital software for the booting and running of other application software, it then suffices that system software are

Group of programs which perfectly interact and handle the hardware devices. This group of program is called the OPERATING SYSTEM SOFTWARE.

Having install the operating system software, other application software can now be put inside the computer since the (O.S) serve as a gateway program between the computer Hardware and the Application Software, hence without the Operating System Software, the Computer becomes useless and cannot function to any length.

Below are the few Software needed for running of the Computer activities.

S/NO	SOFTWARE REQUIREMENT
1.	OPERATING SYSTEM SOFTWARE ▶ WINDOWS '95 OR 98
2.	APPLICATION SOFTWARE ▶ MICROSOFT OFFICE 97 ▶ DBASE IV FOR WINDOWS ▶ CLIPPER 2.0 ▶ WORDPERFECT 6.1 FOR WINDOWS ▶ AND OTHER NECESSARY SOFTWARE

4.3 CAL INSTALLATION

Installation is the process of transferring the designed CAL Program from the Floppy Disk (FD) to a Permanent Storage Device called the Harddisk (HDD) for proper running of the CAL Program.

Below is the procudre involving for CAL Installation

1 ⟶ Create a Directory name called CAL TUTOR with the format below:-

C:>MD CAL.TUTOR ↵

2 ⟶ Change Directory to CALTUTOR by using the format below

C:>CD CALTUTOR↵

3 ⟶ C:/>CALTUTOR>

The above then become the active directory

4 ⟶ Change default Drive to A by typing

C:/CALTUTOR A : ↵

5 ⟶ At A-prompt I.e. A:/>

Copy all the files in Drive A to C

Using the below format

A:/>Copy *.* C:↵

From the above format *.* means that the computer should copy all the files available in the Drive A to destination drive C.

6 ⟶ Change Default drive back to C by typing

A:/> C:↵

7 ⟶ At C-prompt I.e C:/CALTUTOR>

Type TUTOR to run the CAL Program

C:/CALTUTOR> TUTOR ↵

8 ⟶ Welcome to COMPUTER ASSISTED LEARNING STAGES OF FERMENTATION PROCESS Is displayed on the Computer Screen.

4.4 TEST RUNNING OF CAL

The CAL is run on the computer and checked to be sure that is satisfy the aim for which is was designed.

Obviously, few now, there is no error, it has been fully run, tested and validated and found to be okay, even though the program is still subject to any modification as a result of errors, hence the project author is waiting for criticism for improvement on the software. Note that debugging is the process of removing errors (logical, semantic and syntax) from a program to be sure that the program will execute successfully.

4.5 SYSTEM ANALYSIS AND COST BENEFIT

This involves the actual fixed cost plus the variable cost if the running cost of obtaining and maintaining the computer system both on the side of Hardware and Software.

However, it is true that the cost of obtaining both the hardware and software requires may be expensive on the side of an individual but for an organization, it will stand the test of time and improve the familiarization of staff on the computer system, perhaps its is a long lasting profitable asset as it is a fixed asset altogether. Below are the cost benefit of obtaining the hardware and software in a tabular form.

A. COST BENEFIT FOR HARDWARE REQUIREMENT

S/NO.	HARDWARE DESCRIPTION	QTY	RATE	AMOUNT
1.	Complete computer system IBM compatible with Multimede's facilities	1	165,000	165,000.00
2.	Automatic Voltage regulator (A.V.R.)	1	45,000	45,000.00
3.	Un-interupted power supply (UPS).	1	65,000	65,000.00
	SUB-TOTAL OF (A)			**275,000.00**

B. COST BENEFIT FOR SOFTWARE REQUIREMENT

S/NO.	HARDWARE DESCRIPTION	QTY	RATE	AMOUNT
1.	Operating System Software			
	→ Window '95 or 98	install	35,000	35,000.00
2.	Application Software			
	→ Microsoft office '97	install	45,000	45,000.00
	→ Word Perfect for Window			
	→ Dbase V for Windows			
	→ Clipper 2.0			
	Caltutor & Training			
	(1) Staff	install	20,000	20,000
	SUB-TOTAL OF (B)			**145,000.00**

SUMMARY OF (A) & (B)

S/NO.	SUMMARY OF (A) & (B)	AMOUNT
A.	HARDWARE COST	275,000.00
B.	SOFTWARE COST	145,000.00
	TOTAL	**420,000.00**

CHAPTER FIVE

5.0 CONTRIBUTION OF CAL ON STAGES OF FERMENTATION

5.1 SUMMARY

The Computer Assisted Learning (CAL) on stages of fermentation process is divided into five chapters.

Chapter one (1) of this project work dealth with Introduction, Definition of Fermentation, Concept of Fermentation, Objective of Fermentation and Scope of Study.

Chapter two (2) focuses attention on the literature Review, Historical Background of Fermentation and relevance of CAL in the area of fermentation.

Chapter three (3) lay emphasis on system analysis and design generally, it started with definition of System Analysis, Stages of System Analysis and Design.

The proposed system and its relevance was also discussed. Artificial Intelligence which is the root of expert system and CAL were also discussed. Fields of artificial intelligence were also not left untouched, just like the features of computer assisted learning was also discussed.

Detail of Database files and text file used were also discussed in this chapter.

However, chapter four (4) talk on CAL implementation, Hardware and Software requirement, CAL Installation and test running was explained, system cost benefit on the side of hardware and Software were also given proper attention.

Lastly, chapter five (5) summerises the whole chapters with a reasonable conclusion and proper recommendation were also made for further improvement on in Nigeria.

5.2 CONCLUSION

Conclusively, it is suffice to say that this program has been written, tested, validated and found to be efficient and effective in its dimension.

5.3 RECOMMENDATION

As we are about moving into another area of information technology, that is a new millennium, it is wise for us to start embracing the idea of using and understanding computers in our daily life, because whether we like it or not, it has come to stay and no going back.

The Richest Man on earth today (Bill Gate, CEO of Microsoft Corporation) makes a turnover of 18 Billion Dollars in 1997 in the name of information technology which is three times what Nigeria as a country make in 1997.

In view of the above:-

1. I recommend that the Federal Government of Nigeria should please encourage individual, corporation bodies and all levers of information technology to join hand together and make Nigeria a greater nation in this aspect of information technology.
2. Since the proposed CALTUTOR is not a case study of any organisation, it is recommended that the CALTUTOR should be distributed through installation of various higher institute of learning to enable all students of industrial technology to have a feeling of the Computer Assisted Learning (CAL) on stages of fermentation process.

APPENDIX

```
09,1 prompt " 2. CHAPTER TWO   - Definition, Concepts & Objectives....."
11,1 prompt " 3. CHAPTER THREE - Stages of Fermentation..............."
13,1 prompt " Exit CAL Sub Menu....................................."

nu to fchoice
ve screen to sc_vpop
 case
 CASE fchoice = 0
      loop
 case fchoice = 1
      !attrib +r chap1.txt
      !edit chap1.txt
 case fchoice = 2
      !attrib +r chap2.txt
      !edit chap2.txt
 case fchoice = 3
      !attrib +r chap3.txt
      !edit chap3.txt
 othe
      exit
dcase
ea
store Screen from sc_vpop
ddo
turn
------------------------Menu Choice for Q_A--------------------------------
ocedure Q_A
 while .t.
t color to w+/b
06,30 clear to 14,62
06,30 to 14,62

1,08 clear to 23,71
1,08 to 23,71
2,10 say 'Use '+chr(25)+' or '+chr(24)+' key to highlight option & press '+c
07,31 prompt " 1. Question on Chapter One...."
09,31 prompt " 2. Question on Chapter Two...."
11,31 prompt " 3. Question on Chapter Three.."
13,31 prompt " Exit Menu....................."

nu to ch2
ve screen
 case
 case ch2 = 0
      loop
 case ch2 = 1
      do QA1
 case ch2 = 2
      do QA2
 case ch2 = 3
      do QA3
    other
      exit
dcase
st Screen
ddo
turn
------------------------------------------------------------------------------
 g=0
 @00,00 clear to 04,79
 @00,00 to 04,79 color "w+/r"
 cus1="COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION"
 cus2="(Chapter One - INTRODUCTION)"
 @01,(80-len(cus1))/2 say cus1
```

```
Set Talk off
Set Echo off
Set Bell off
Set Stat off
Set Scor off
Set Safe off
Set Conf off
Set Esca off
Set Wrap on
set proc to clap
Set date to brit
Private sc_hpop  // Saves horizontal popup
Clear
*do floor
 = inkey (2)
Set color to w+/br, ,
do lftcarpet
@ 00,00 clear to 05,79
@ 00,00 to 05,79 color "w+/r"
depot1="COMPUTER ASSISTED LEARNING ON"
depot2="STAGES OF FERMENTATION"
@ 01,(80-len(depot1))/2 say depot1
@ 02,(80-len(depot2))/2 say depot2

Do while .t.

@21,08 clea to 23,71
@21,08 to 23,71
@ 22,10 say 'Use '+chr(25)+' or '+chr(24)+' key to highlight option & press '+c
@ 04,01 prompt "C A L   TUTOR"
@ 04,30 prompt "TUTOR'S TEST"
@ 04,70 prompt "Exit"
Menu to ch1
Save screen to sc_hpop
Do case
   case ch1 = 1
        do CAL
   case ch1 = 2
        do Q_A
   othe
        exit
Endcase
Restore Screen from sc_hpop
Enddo
Clear
@ 23,01 say "CAL, Undergoes Normal Shut Down...!!!"
?
?

?
Return
*-------------------------Menu Choice for manager-------------------------
Procedure CAL
Private sc_vpop
Do while .t.
Set color to w+/b
@ 06,00 clear to 14,59
@ 06,00 to 14,59

@21,08 clear to 23,71
@21,08 to 23,71
@ 22,10 say 'Use '+chr(25)+' or '+chr(24)+' key to highlight option & press '+c
@ 07,1 prompt " 1. CHAPTER ONE    - Introduction To Fermentation....."
```

```
@03,(80-len(cus2))/2 say cus2
xpage=1
if xpage=1
    g=g+1
 endif
@02,63 say "CAL Page No.: "+ltrim(str(xpage))
@07,05 clea to 19,75
@07,05 to 19,75 doub
do action
   set proc to chapter1
   do pager1
i=0
do while .t.
   i=inkey(0)
   if (i = 18) .or. (i = 3)
      exit
    endif
enddo
   *Pager1="page"+ltrim(str(xpage))
   *on key label PgUp do Pager1 && -------------- Previous Page  ----------
   *on key label PgDn do pager  && --------------    Next Page   ----------

 *Pagerg="page"+ltrim(str(xpage+))  && Next Page

 *Pagerg="page"+ltrim(str(xpage+g))  && Next Page



*------------------------- Actual Page Movement -------------------------
 if (i = 18) .and. xpage=1
    xpage=1
    @02,63 say "CAL Page No.: "+ltrim(str(xpage))
    do pager1
 Endif

 if (i = 3) .and. xpage=1
    xpage=xpage+1
    @02,63 say "CAL Page No.: "+ltrim(str(xpage))
    do pager2
 Endif

 if (i = 18) .and. xpage=2
    xpage=1
    @02,63 say "CAL Page No.: "+ltrim(str(xpage))
    do pager1
 Endif
 if (i = 3) .and. xpage=1
    xpage=xpage+1
    @02,63 say "CAL Page No.: "+ltrim(str(xpage))
    do pager2
 Endif

 if (i = 3) .and. xpage=2
    xpage=xpage+1
    @02,63 say "CAL Page No.: "+ltrim(str(xpage))
    do pager3
 Endif

 if (i = 18) .and. xpage=3
    xpage=1
    @02,63 say "CAL Page No.: "+ltrim(str(xpage))
    do pager1
 Endif
```

```
if (i = 3) .and. xpage=3
   xpage=4
   @02,63 say "CAL Page No.: "+ltrim(str(xpage))
   do pager4
Endif

if (i = 3) .and. xpage=3
   xpage=5
   @02,63 say "CAL Page No.: "+ltrim(str(xpage))
   do pager5
Endif
*------------------------- End of Chapter One --------------------------
   set cons off
   wait
   set cons on
return
*-------------------------------------------------------------------------------
@00,00 clear to 04,79
@00,00 to 04,79 color "w+/r"
cus1="COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION"
cus2="(Chapter Two - DEFINITIONS, CONCEPTS & OBJECTIVES OF FERMENTATION)"
@01,(80-len(cus1))/2 say cus1
@03,(80-len(cus2))/2 say cus2
@02,63 say "CAL Page No.: "

@07,05 clea to 19,75
@07,05 to 19,75 doub
do action
wait " "
etu
-------------------------------------------------------------------------------
@00,00 clear to 04,79
@00,00 to 04,79 color "w+/r"
cus1="COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION"
cus2="(Chapter Two - DEFINITIONS, CONCEPTS & OBJECTIVES OF FERMENTATION)"
@01,(80-len(cus1))/2 say cus1
@03,(80-len(cus2))/2 say cus2
@02,63 say "CAL Page No.: "

@07,05 clea to 19,75
@07,05 to 19,75 doub
do action
wait " "
tu
```

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation)

WELCOME TO COMPUTER ASSISTED LEARNING

(Chapter 1 - Introduction To Fermentation)

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1.0 INTRODUCTION TO FERMENTATION

The Study of the process of fermentation has engaged Scientists for a long time. Notable among early workers are :-

(1). Schwann, (2). Liezbig, (3). Wohler, (4). Cagniardlatoin, (5). Pasteur, (5). Berzelus.

Action Bar

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For a very long time, the principle of fermentation was not clear. There was two school of thought, namely the Vitalistic and Mechanistic.

The Vitalistic approach is that there is vital force outside the cell that control fermentation.

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THE CONCEPTS OF FERMENTATION

The concept of fementation isto strike a strict balance between oxidation and reduction.

Pyridine nucleolide is reduced in one step of the process and

then oxidized in another step of the process.The product formed depends on the ability to strike a balance between oxidation and reduction.

OBJECTIVES OF FERMENTATION

The objectives of fermentation is to use micro-organism like yeast to convert organic substrate like sugar into fermented products like alcohols etc.

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation)

THANKS FOR GOING THROUGH THIS COMPUTER ASSISTED LEARNING

(Chapter 1 - Introduction To Fermentation)

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Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 2 - Definition, Concepts and Objectives of Fermentation)

WELCOME TO COMPUTER ASSISTED LEARNING

(Chapter 2 -Definition, Concepts & objectives of Fermentation)

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Use Page Up = > Previous Page / Page Down = > Next Page

DEFINITION OF FERMENTATION

Fermentation is an ATP generating metabolic process in which organic compound serve both as electron donor or electron accpetor.The compound that perform this two functions are usually two different metabolite derived from a single fermentabl

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

substrate such as sugar. Simply put fermentation is the anaerobic breakdown of sugar to release alcohol.

Action Bar

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation) CAL Page 3

The mechanistics school of thought was that fermentation is is control by chemical events in cell.

Pasteur, a microbiologist and biochemist, define fermentation as the consequences of life without air (anaerobic condition). But the true nature and reaction mechanism of fermentation was

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation) CAL Page 4

discovered by chance in the late 19th century.

Buchner et al extracted portion of yeast for medicinal purpose but found that the extract reacted with sucrose which was introduce into the medium as preservative,this discovery is said to have given birth to modern Biochemistry. This reaction

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation) CAL Page 5

showed that part of living system could be made to react with pure compund in vitro.

Edward Bukhev was able to establish that alcoholic fermentation was mediated by a yeast enzyme, thus he was the first to demonstrate enzyme mediated fermentation reaction. He named the

yeast enzyme Zymane, but it is now known that the enzyme is not a single enzyme but a series of enzymes which make up the Embolem Meyerhoff pathway for sugar catabolism.It is also known that this enzyme are not extra-cellular but within the yeast cell and this defeat the theory of vitalism.

The underline unity among micro-organisms was established by Kluyuer in 1924 when he observed that by adjusting such parameters as growth medium or culture conditions, one could change the types of metabolic intermediate or end products which accumulate during the growth of various micro-organisms. His study

allow a more rational approach tothe study of microbial physiology, and led to the understanding that they could be manipulated to yield the desire product of economic values.

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation) CAL Page 9

SCOPE OF THE STUDY

This project is amied at looking at the following areas of fermentation for proper understanding of the process.

(i). Fermentation Media

(ii). Type of Fermentation Media

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation) CAL Page 10

(a). Simple Media

(b). Complex Media

(iii). Buffering of Media

(iv). Media Economics

(v). Stages / Steps in the process of Fermentation using the

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 1 - Introduction To Fermentation) CAL Page 11

following examples : Alcoholic Fermentation

(vi). Examples of application of alcoholic fermentation.

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 2 - Definition, Concepts and Objecives)

THANKS FOR GOING THROUGH THIS COMPUTER ASSISTED LEARNING

(Chapter 2 -Definition, Concepts & Objecives of Fermentation)

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Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation)

WELCOME TO COMPUTER ASSISTED LEARNING

(Chapter 3 - Stages of Fermentation)

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Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

FERMENTATION MEDIA

The choice of fermentation media is as important to the success of industrial fermentation as it isolate and maintain organism to carry out fermentation.

The medium supply nutrient for the growth fermenting organisms,

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

which inturn supply the enzymes for fermentatio.The medium also supply Amino acids,Antibiotic, vitamen etc of particular importance are sources of carbon, nitrogen, phosphorous.

The medium also contain growth factors like inorganic acids and certain procursor of fermentation eg pectin for pectinic enzyme

Action Bar

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 3

A poor joice of media component can result in limited growth of fermenting organisms and thus affect the yield of products.

For designing a medium, the general concepts to be followed include :

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 4

(1). Adequate concerntration of all elements must be provided in the medium to produce cells of expected composition, so as to give the required product yield.

(2).The medium should contain specific nutritonal requirement such as purines,pyrimidenes,Amino acid & water soluble vitami

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 5

(3). Sufficient amount of energy source and this will be base on the yield constant

$$\text{Yield Constant} = \frac{\text{g of cell}}{\text{g of substrate}}$$

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 6

TYPES OF FERMENTATION MEDIU

There are two main types of fermentation media : Simple and Complex media.

SIMPLE MEDIA : They are made up of inorganic acids or organic salts or nitrogen salts and use in addition to

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 7

sunlight. They are use for autotrophic bacteria

COMPLEX MEDIA :There two groups of complex media i.e SYNTHETIC and CRUDE media.

In the SYTNTHETIC medium,the contituent is known so the media is well define e.g the medium by

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 8

Rolze and Cabrera (1980) where we have :

(NH4)2So2	= 20.75g
MgSo4	= 1.59g
H3Po3	= 3g
Sugar(glucose/fructose)	= 2%

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 9

This is made up to 1 litre.

Synthetic medium has the following advantages :

(1). The amount of any one component or several component can easily be verified to determine its specific effect on cell growth and product yield

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 10

(2). The recovery and purification of fermentation product are relatively simple because extraneous compound are not include and the compound which interfer are known.

(3) It aid reproductivity ofthe organism & production

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 11

the CRUDE MEDIUM, their constituents are not well defined, ey can be made from Soya beans meal, Molares(water materials om sugar),sulfite liquor(by products of pulp paper industry), rn steep liquor(n both corn oil & corn starch industry)yeast

extract etc.

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 12

The crude media are cheaper, source crude media include :

(1). MOLARES : It is a by product of sugar industry and they called SERUP recover at one or the several steps, and the stage at which its is obtain in use to name it.Black strap Molares is the cheapest obtaind during the cooking process

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 13

and is mainly use during industrial fermentation. Other factors are added to the medium.

(2). CORN STEEP LIQUOR :It is,often use in feeds and antibiotic especially penecilin. Corn steep medium normally obtain from steeping corn in corn oil or starch industry. Corn

Action Bar

Use Page Up = > Previous Page / Page Down = > Next Page

COMPUTER ASSISTED LEARNING ON STAGES OF FERMENTATION

(Chapter 3 - Stages of Fermentation) CAL Page 14

steep medium can be in liquid, semi solid or solid medium. Other important growth factors are added.

FFERING OF MEDIA

loyed.These media materials are usually by-products of agricul-
tural production. The cost of getting may fluctuate in demand &
supply as well as the industry that use these materials as raw

Action Bar
Use Page Up = > Previous Page / Page Down = > Next Page

aterials for production.

f there are several media, the medium that allow for rapid
rowth and high cell yield are best for production of fermenta-
ion medium. However,there are certain industrial process where
estricted cell growth is good for fermentation,this is because

Action Bar
Use Page Up = > Previous Page / Page Down = > Next Page

reater amount of substrate are fermented into products instead
cell growth.

Action Bar
Use Page Up = > Previous Page / Page Down = > Next Page

THANKS FOR GOING THROUGH THIS COMPUTER ASSISTED LEARNING

(Chapter 3 - Stages of Fermentation)

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PRESS {X} TO EXIT CHAPTER TWO

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