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FACTORS AFFECTING RATE OF BACTERIAL GROWTH DURING BIOGAS PRODUCTION FROM BANANA PLANT

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ABSTRACT

India is a Agricultural country, where Banana cultivation is in practice in large part of country. After removal of fruits the entire plant become a waste material causing pollution in burning of dried Biomass. The banana Biomass contains 90% water and 10% of cellulose and protein component. This Biomass can be used for production of Biogas by anaerobic termination. Bacteria present in semi digested Bio-mass reportedly grow in numbers specially during Bio methanation process, being longer in duration of time. The growth of bacteria depends on Environmental factor and also on genetic constitution of bacteria. Immortality of bacteria largely depends upon temperature. A very high temp. above 60^0c caused gradual death of Bacteria.

KEY WORDS

Bacteria, Anaerobic fermentation, Environment, Bio-mass, Cellulose, Biogas, Constitution.

INTRODUCTION:

Growth and metabolism of bacteria produces CH^4 and other gases, depends upon the type of bacteria and kind of substrate for ex. Methanobacterium found in Rumen of Cow play significant role in production of Biogads from Banana plant. Fermentation time can be extended by increasing percentage of C, N, Vitamins and minerals in sample under experimentation most bacteria are mesophilic that grow at moderate temp 25^0-40^0 c. other bacteria may be Psychrophiles (low temp.), thermophiles (hight) hyper thermophile (very high temp.) Depending upon the density of O2 they are Aerobes (requires O_2) or

Anaerobes (O_2 not required, Airotolerant (Survive in small amount of O_2) or facultative anaerobic (O_2 may be or may not be).

O_2 also found toxic for many bacteria- bacteria are also Acidophilic (Ph 0-5.5), Neutrophilic (Ph 5.5-8) or Basophilic (Ph 8.5 - 11.5)

KINETICS OF BACTERIAL GROWTH AND DEATH

Homogeneous suspension of bacteria when heated at Continuous temp (60^0C), death follows the logarithmic order by the factor of ten and is called as Decimal reduction, time (0) value is expressed in time large value of 'D' indicate that 't' will be longer. TDT is thermal death time. The process of lethality can be described as

F_T^Z = (121.1^{O}C) (250^{O}F)

Z = 10^O (18^Of)

F_O = No. of minutes requires for lethal Killing

$$F_T^Z = F_{Tref.}^Z \quad \frac{T_{ref.}-T}{10^z}$$

$$F_T^{10} = F_0 \frac{121.1-T}{10 \quad 10} = \frac{121.1-T}{10 \quad 10} = = -10^{10/10} = 10^{-1} = 0.1 \text{ mint.}$$

$$T = 131.1^O C, \; F_{131.1}^{10} = \frac{121.1 - 121.1}{10 \quad 10} = 10^{10/10} = 10^{1=} 10 \; minutes$$

T= 111.1^{O}C, F^O111.1 = $\frac{121.1-111.1}{10 \quad 10}$ = $10^{10/10} = 10^1$ = 10 minutes

the decrease of bacterial population is first order reaction Nutritional loss in thermal treatment is also first order reaction.

k = 2.303 log $_{10}$ (No/N)

Half life Period F = D $\log_{10}$ (No/N)

D log (No/N) = t =F (log cycle reduction)

EXPERIMENTAL PROCEDURE

6 kg of day Biomass of Banana plant is washed with EDTA and water to remove the impurities present in sample now Biomass is grinded to convert it into a paste. The bacterial density measured by taking 2 gm of sample in solution form by dry cell weight method or by spectro photometer. The sample is now divided into three parts equally 2 kg of each.

I. In first case 2 kg of Banana Biomass is taken and mixed with 2 liters of water and also added with NaOH to remove unwanted particles the sample is taken as Blank. Experiment temp 40^{o}C and pH at 7.8 was maintained.

II. In second case 2 kg of Biomass mixed with 1/2 kg of Pig manure is taken and converted into semi solid state by mixing with 2 liters of water and left for 60 days for complete digestion temp at 35^{o}C at pH at 7.0 was maintained.

III. In third setup 2 kg of Biomass converted into slurry and mixed with 1/2 kg of 7 cow dung and left for 60 days for digestion/ temp was 30°C and Ph was at 6.5 was maintained.

RESULT AND DISCUSSION - Study of tables reveals that.....

I. In experiment No. 1 the density of Bacterial population was measured by photo spectrometer and reported lowest density as killing of bacteria was more pronounced at elevated temperature.

II. In second experiment the bacterial density was higher than experiment no.1 but less then experiment No. 3 because of presence of pig manure and basic nature of media.

III. In experiment No. 3 the bacterial populated was reported highest the medium was mixed with cow dung which act as favorable media for growth even after completion of biomethanation.

IV. Reportedly Ph 6.5 temp 30°C and presence of little cow dung in favoring the growth of bacteria in Biomass even after the concluding of CH_4 producing step i.e. biomethanation and addition of charge will continue to produce Biogas.

Table-1

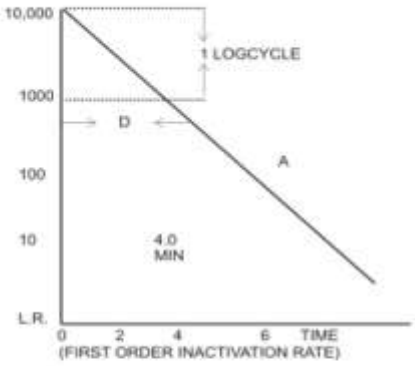
S.No.	Feed Material	PH.	Temp. °C	Time in day	No. of Survivors	Biogas
1	2 Kg of Banana dry Mass	7.8	40^o	14	$1.2X10^3$	529L
2	2 Kg of Banana D.M. with 1/2 kg of manure	7.0	35^o	22	$1.1X10^5$	580L
3	2 kg of Banana D.M. and 1/2 Kg of Cow Dung	6.5	30^o	28	1.0×10^6	655L

TABLE - 2

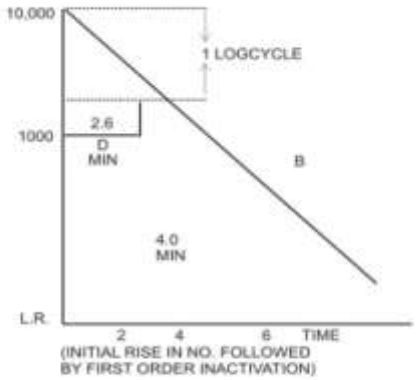
S.No.	Time in Days	Midpoint Temp °C	Lethal rate of Bacteria
1	0.8	107	0.001
2	1.8	114.8	0.005
3	3.8	128.7	0.094
4	4.8	132.9	0.226

5	5.8	136.25	0.456
6	6.8	138.3	0.701
7	7.8	139.3	0.882
8	8.8	140.0	1.007
9	9.8	140.0	1000
10	10.8	140.0	1000
11	11.8	140.0	1000
12	12.8	129.2	0.104
13	13.8	117.25	0.008
14	14.8	111.0	0.002
15	15.8	108	0.001

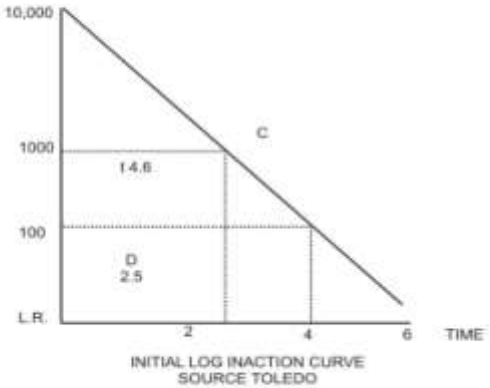
MICROBIAL INACTIVATION CURVES



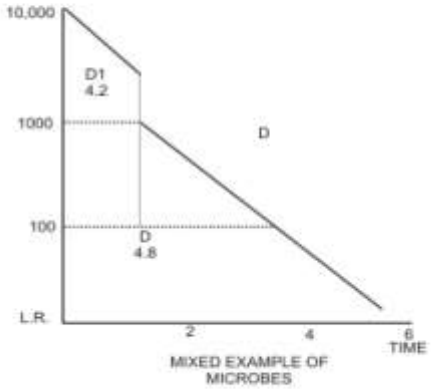
(FIRST ORDER INACTIVATION RATE)



(INITIAL RISE IN NO. FOLLOWED BY FIRST ORDER INACTIVATION)



INITIAL LOG INACTION CURVE SOURCE TOLEDO



MIXED EXAMPLE OF MICROBES

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