Appl Microbiol Biotechnol (1985) 23:75–76

Applied and Microbiology Biotechnology

A simple device for controlled feeding of pasty materials used as fermentation substrates

Roque A. Hours and Alberto Massucco

Centro de Investigación y Desarrollo en Fermentaciones Industriales, Facultad de Ciencias Exactas UNLP, 47 y 115, 1900 La Plata, Argentina

Summary. A simple device is described for controlled feeding of pasty materials in laboratory scale fed-batch cultures. The device was tested with apple pomace as raw material for production of microbial biomass, using the level of dissolved oxygen as controlled parameter.

Introduction

In recent years much attention has been paid to the use of agricultural wastes as components of fermentation media (Smith 1980). The use of these raw materials which present disposal problems, may be advantageous, considering its low or negative cost.

Some of these wastes, such as those produced from squeezed fruits like apple pomace, are usually pasty materials which adhere to the walls of the containers, making its handling in fermentation processes very difficult, particularly if it is desired to employ them in fed-batch experiments.

This note deals with the design of a simple device for controlled feeding of pasty materials at laboratory scale.

Methods

The equipment used is shown diagramatically in Fig. 1. To prevent any possible interactions between the substrates and the containers, all parts of the equipment in contact with the substrate were made of PVC. In this design, the materials were discontinuously loaded in the cylinder (Fig. 1, 10) under non-sterile conditions. A manually operated piston (Fig. 1, 9) was pressed till a continuous flow of the paste was obtained through the bottom of the cylinder (Fig. 1, 11). After that, the apparatus was attached to the fermentor jar.

Results and discussion

The control unit is depicted in Fig. 2. Any parameter associated with a metabolic activity such as pO_2, pCO_2, pH, carbon and nitrogen source level, etc., can be used as control signal (Gleiser et al. 1981; Hopkins 1981; Huang et al. 1981). The in-

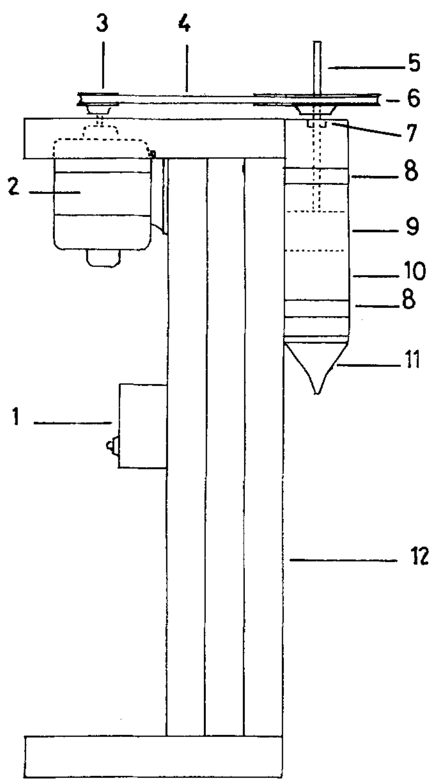

Fig. 1. Feeding device assembly. *1:* Motor speed control; *2:* 220 V, 1/2 HP, 1800 rpm universal motor; *3:* 72 mm (external ∅) drive pulley; *4:* Drive belt; *5:* 3/8″ screwtread; *6:* 192 mm (external ∅) drive pulley; *7:* 3/8″ nut; *8:* Clamp; *9:* PVC 100 mm (external ∅) piston; *10:* PVC 100 mm (internal ∅) cylinder; *11:* Output to the jar; *12:* Stand

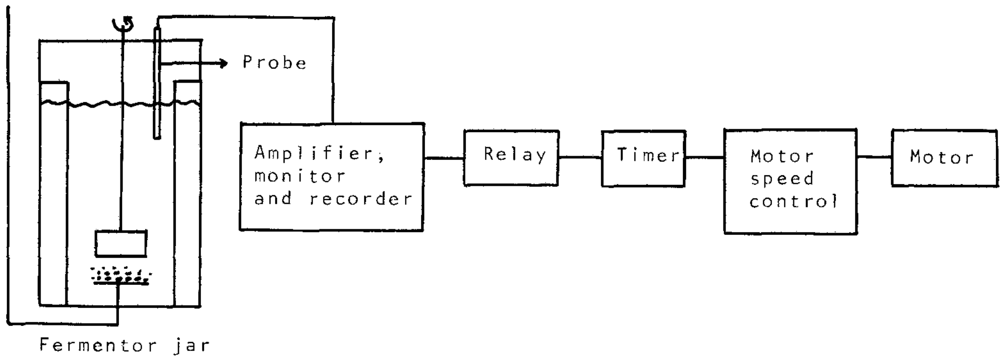

Fig. 2. Control Unit

put signal recorded and amplified was compared to the control circuit with a reference signal switching on or off a relay which, in turn, operated the feeding device. This was provided with a timer which can be set according the dosing intervals required. On line with the motor there is a speed control to select the desired rate of feeding. With this particular method of control assembly, a fine regulation of substrate addition can be achieved. The possibility of independent and continuous variation of the reference level, with the dosing intervals and the motor speed allows a suitable adjustment of the apparatus to the particular needs of the operator.

The use of the feeding device was tested in a fed-batch process carried out with apple pomace, by using a strain of *Trichoderma reesei* in a 4 l LKB Ultroferm 1601 fermentor. The culture medium, analytical techniques and fermentation conditions used have been described in a previous paper (Hours et al. 1985). The control strategy was to couple the dissolved oxygen signal with the apple pomace supplied.

Figure 3 shows the values of oxygen dissolved and total volume of medium corresponding to a period of 10 h of a typical fed-batch experiment. It can be seen that the system become stabilized after 6 h. The frequency of additions increases with the increase of biomass as has been observed in several experiments. At 56 h the feeding was stopped; this produced a sharp increase in the concentration of the oxygen dissolved.

The dosing device is simple, cheap and easy to construct and quite suitable for laboratory experiments.

Acknowledgements. This work was supported by the Argentina Research Council (CONICET). The technical assistance of C. Castro and A. Bonelly is gratefully acknowledged.

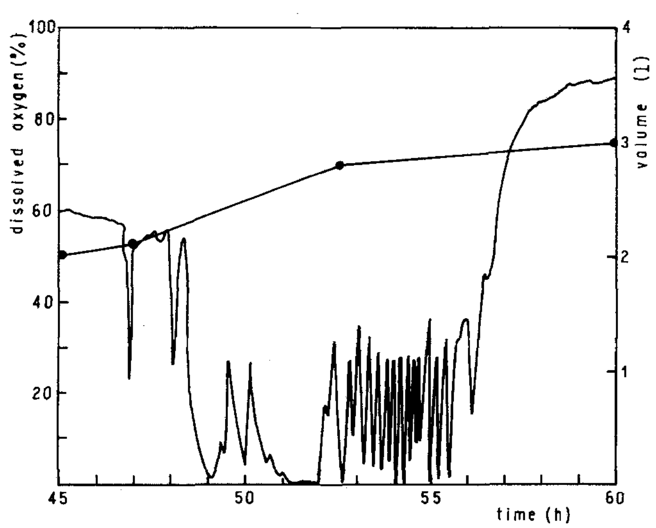

Fig. 3. Oxygen dissolved and total volume of a fedbatch experiment

References

Gleiser IE, Bauer S (1981) Growth of *E. coli* W to high cell concentration by oxygen level kinked control of carbon source concentration. Biotech Bioeng XXIII:1015–1021

Hopkins TR (1981) Feed-on-demand control of fermentation by cyclic changes in dissolved oxygen tension. Biotech Bioeng XXIII:2137–2143

Hours RA, Massucco AE, Ertola RJ (1985) Microbial biomass product from apple pomace in batch and fed batch cultures. Appl Microbiol Biotechnol 23:33–37

Huang SY, Chu WB (1981) Automatic control for fed-batch culture of single cell protein. Biotech Bioeng XXIII:1491–1499

Smith JE (1980) In: Bewich M (ed) Handbook of Organic Wastes Conversion. Van Nostrand Reinhold, New York

Received March 21, 1985/Revised June 27, 1985