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Outline of the Fungal G. Process.

How it could be applied to Coffee wastes.
Single Cell Protein from both Liquids and Solids.

Dr. Peter Henry from Australia, the developer of the Fungal G. process, originated his basic work with animal manure. He discovered that by allowing dilute manure slurry to ferment, the end product was largely short chain volatile fatty acids or SCVFAs, usually lactic, and acetic acids which lowered the pH to around 4. That is less than the acidity of Coca Cola, around 3.6. However, when the pH was lowered slightly more with a mineral acid, such as dilute phosphoric sulphuric or hydrochloric acid, the disassociated SCFVAs were all protonated back into un-ionised acid molecules, and these same molecules proved to be very powerful germicides, achieving 100% removal of all known pathogens in a matter of hours. This is a bit like Joseph Lister the early Surgeon, who sprayed carbolic acid everywhere. Furthermore, when the manure slurry was filtered to remove the solids, the clear filtrate was a very stable, well preserved low pH solution , which would not deteriorate any further, except that it would grow a clean surface pellicle, making a soft biscuit of edible yeasts and moulds, akin to the ersatz cheese produced by Germany to feed its population during two world wars. By using filamentous hydrophobic organisms all the problems of separating out fine individual cells from a watery solution just do not arise. Nevertheless, the task of learning how to cultivate these same organisms in a commercially profitable environment, has taken a great deal of effort and resulted in a radically different system to conventional submerged aerobic systems used for growing single cell protein..

Whilst I was researching coffee wastes during my tenure at the Papua New Guinea Coffee Research Institute, in the late 90s, I signed an agreement with Dr Henry, to do further work on his base patents. I first of all made SCP from fermented coffee waste water along his original lines of research. The major naturally occurring organism involved turned out to be Geotrichum candida which is easily recognised as the white crust that grows on factory made Camembert cheese.

I then proceeded to work on a solids process with coffee pulp silage. By making silage of the fresh pulp, and storing it for several months, Lactobacillus plantarum not only ensiled the pulp and preserved it but it also, given time, should have attacked the alkaloids and tannins and broke them down for their nitrogen. I was anxious to confirm earlier published research by others and put numbers on this process, but I was not then able to do this.

Then, during the off season for coffee processing I opened up the detoxed silage and quickly sprayed it with a mix of dilute phosphoric acid, and S.O.A, to A/., preserve its colour which is pH dependant, all those red coloured antioxidants. And to B/., start a further solid state fermentation process by slowly tumbling it in a small conventional coffee drier` without added heat. This aerates the acid mixture, which then proceeds to both grow Geotrichum on the surface of the pulp, and to dry it, with the metabolic heat from the fermentation. This brought it down to around 20% moisture, which felt dry but was not enough to fully preserve it. (This initially required a touch of extra heat which was no problem for a coffee drier, but I am confident could be done without by adding some molasses to the mix. That would give more metabolic heat and ramp up the protein level.) This second fermentation used up the original lactic, acetic and other acids from the silage process and converted them to single cell protein. In its finished state it was packed in air tight bags and kept for about two months. With further development this could be surely extended.

The unfortunate bit was that there were no cattle available in the Highlands of PNG to test feed the material, and my contract expired before I could have it analysed for protein content, nucleic acids and residual alkaloids etc.

Appendix.

More details on the Fungal G process.

The Fungal G process is a new low energy method for the aerobic BOD reduction of waste waters, which can handle more concentrated and more toxic effluent streams than present conventional fermentation practise allows. Fungal G. is basically a trickling filter system, but the key difference to this patented process is the use of hydrophobic rather than hydrophilic micro-organisms. It is this difference which allows the use of very concentrated solutions, high pressures normally have to be used for aeration in deep tanks, and if the organisms are heat sensitive, then there is often a lot of low level heat to be pumped out of the system, usually across a very small delta T.

Within the traditional fermentation processes, contamination with any kind of organism that produces a build up of foam or scum, adhesion of slime to working surfaces, or crusts and pellicles to form on un-agitated liquid surfaces is always considered to be detrimental to the basic process and as such, they need to be avoided. Nevertheless, it is just these same hydrophobic organisms which have been shown to possess superior qualities to handle the often stringent conditions required in wastes treatment systems.
. The classic example is the growth of moulds on the surface of jam when the lid is not replaced. The water activity of jam is such, and its concentration of sugars and other solutes so high, that nothing can grow in it without being quickly killed by dehydration. However, with the lid off, a mould spore will settle on the surface, extract what ever moisture it requires from the atmosphere, in the vapour phase, through its liquid waterproof raincoat, and then extract only the amount of nutrients that it requires from a very hostile environment, through its special osmotic boots. By effectively insulating

themselves from their immediate surroundings, hydrophobic organisms can propagate in strong concentrated environments where all others cannot survive.

In summary, this means that;

1/. Capital and electricity costs, for the pressure aeration of deep reaction vessels, ponds or tanks, are not required. Nor are the tanks for that matter.

2/. The microbial solids that are generated, come off in large solid slabs which can be simply raked off the floor, and so there are no costs for filtration, DAF, flocculation, or other methods of fine solids separation and coagulation

3/. These microbial solids constitute a high grade of single cell protein and have a cheese like consistency, which in the past has been used for human consumption. They also have the lowest nucleic acid levels of any SCP.

4/. Being hydrophobic, any retained moisture is easily removed. There are no problems with water retention or large volumes of hard to concentrate gelatinous sludge.

5/. A further property of hydrophobicity , is that the working solutions can be much more concentrated and toxic than can be used in normal submerged fermentation processes. Such organisms seem to be able to insulate themselves from almost any kind of osmotic pressure or high salt concentrations.

6/. The only chemicals required for coffee waste water are limestone, a small amount of mineral acid and perhaps some sulphur type amino acids to upgrade the quality of the feedstuff produced. The water to be treated also needs a fairly large negative ORP. Some times this requires extra chemicals.

7/. On the negative side, the plant involved , while not requiring expensive buildings or excavations, does require a very large floor area to accommodate the hanging curtains. And, this can of course be made multistory, if required. Rotating Contactors may also be a possibility.

8/. Some solid materials like fruit wastes if suitably inoculated will grow SCP in the solid state. This only requires rotating drums and a simple blower for heat dissipation.

9/. Whilst the process will drastically reduce the BOD, the effluent still retains much of its original non fertiliser inorganic salts content, and so tertiary cleanup is still required, just irrigate it back over the plantation . How ever this is a lot easier with the great reduction in BOD.

Want to know more. Write to me, its free!
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