A PILOT SCALE SET UP FOR THE MANUFACTURE OF FISH HYDROLYSATE

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This paper describes a set up for a pilot plant with a capacity of 50 kg. raw material per batch for the production of fish hydrolysate by enzymatic hydrolysis. Process flow sheet and complete specifications and functions of individual equipment have been described. Multifunctional equipment designed for this pilot plant set up has reduced the number of equipment considerably.

INTRODUCTION

There has been an awakening all over the world in recent years on the proper utilization of miscellaneous fishes of less commercial value. Emphasis is being shifted from the manufacture of fish meal to various fish products for direct human comsumption. Considerable work has been done on the hydrolysis of fish protein by enzymes like papain to produce hydrolysate rich in peptone (Sen *et al.*, 1962; Sripathy *et al.*, 1962; 1963; 1664; Sripathy, 1975; Deas & Tarr, 1949A; Piccioni, 1937; Hoover & Hokes, 1947; Prabhu *et al*, 1975 and Madhavan (unpublished). The composition of fish peptone has been studied by Sen (1947), Deas and Tarr (1949B) and Sasak & Kmiya (1952). All these studies relate to the standardisation of the process in the laboratory, but none has made any attempt for the commercial production of fish hydrolysate. It was therefore felt necessary to design a pilot plant for the production of fish hydrolysate and bacteriological peptone based on the process (Prabhu *et al.*, 1975; Madhavan, unpublished) developed in the Institute. Design of a pilot plant with details of plant and machinery required is presented in this paper.

EQUIPMENT AND THEIR FUNCTIONS

The pilot plant comprises of the following pieces of equipment. The schematic representation of the various steps involved in the process is given in the flow sheet (fig. 1).

1. Aluminium washing tub of capacity 100 litres — 2 Nos.

Fish is received in a perforated aluminium tub and washed manually under

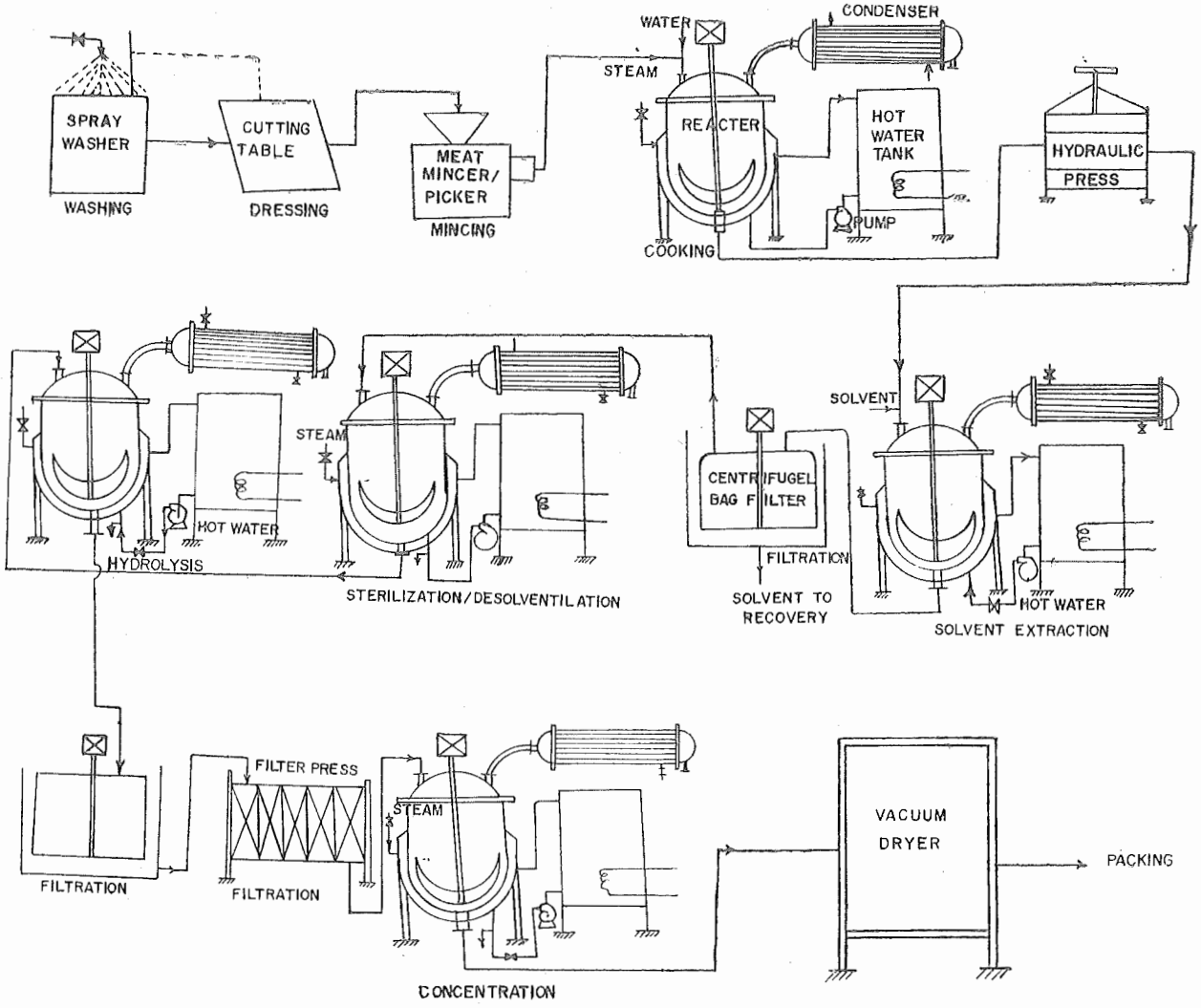

Fig. 1. FLOW SHEET FOR FISH HYDROLYSATE

a spray of potable water from high pressure nozzle to remove external dirt and slime.

2. Processing table of size 0.75×2×0.75m. with aluminium top — 1 No.

After washing the fish is dressed on a wooden table surfaced with aluminium sheet. The dressed fish is taken in another tub and washed as above.

3. Meat mincer of capacity 50 kg. / hr. - 1 No.

Helical type continuous meat mincer is used to mince the fish to 3 to 6mm. particle size as required by the process.

4. Stainless steel reaction vessel of capacity 50 litres — 1 No. (fig. 2)

This is a jacketed reaction vessel fitted with anchor type agitator drive assembly rotating at 50 r.p.m. with heating arrangement by steam as well as hot water (with provision for controlling the temperature of circulating water thermostically between 30-100°C) charging and discharging arrangements, dial thermometer, pressure-vacuum (compound) gauge, and other standard fittings. The vessel is connected to a shell and tube type horizontal condenser fitted with stainless steel tubes for condensing the vapour. This is the most important equipment of the entire plant and performs many functions of the process as described under;

i) Minced fish is taken in this vessel with required amount of water and mixed with the help of the agitator. It is then cooked by passing steam in the jacket. The cooked mass is taken out and pressed.

ii) The cake is again charged into the vessel and fat is removed by solvent extraction at desired temperature by passing hot water into the jacket. The solvent vapour evolved during extraction is condensed and refluxed into the system. After extraction the spent solvent is seperated from the mass by cloth filtration.

iii) The solid is again charged into the same vessel and required amout of water is added. Now steam is passed into the jacket for desolventization of the mass and the residual solvent vapour is collected for repeated use.

iv) After removal of the solvent, the consistency and pH of the slurry are adjusted, charging and discharging doors are closed and the whole mass is sterilized by passing steam into the jacket which generates steam pressure in the interior of the vessel. The sterilization temperature is indicated in the thermometer dial.

v) The sterilized slurry is cooled down to proper temperature as required for hydrolysis by passing cold water into the jacket. Required amount of enzyme is added and the door closed immediately. Hydrolysis is carried out at desired temperature by passing hot water from the thermostatically controlled hot water tank. Hydrolysis can be arrested by heating the slurry by passing steam through the jacket after cutting off hot water circulation.

vi) The slurry is taken out through bottom discharge valve, strained through cloth / paper filter and filtrate collected.

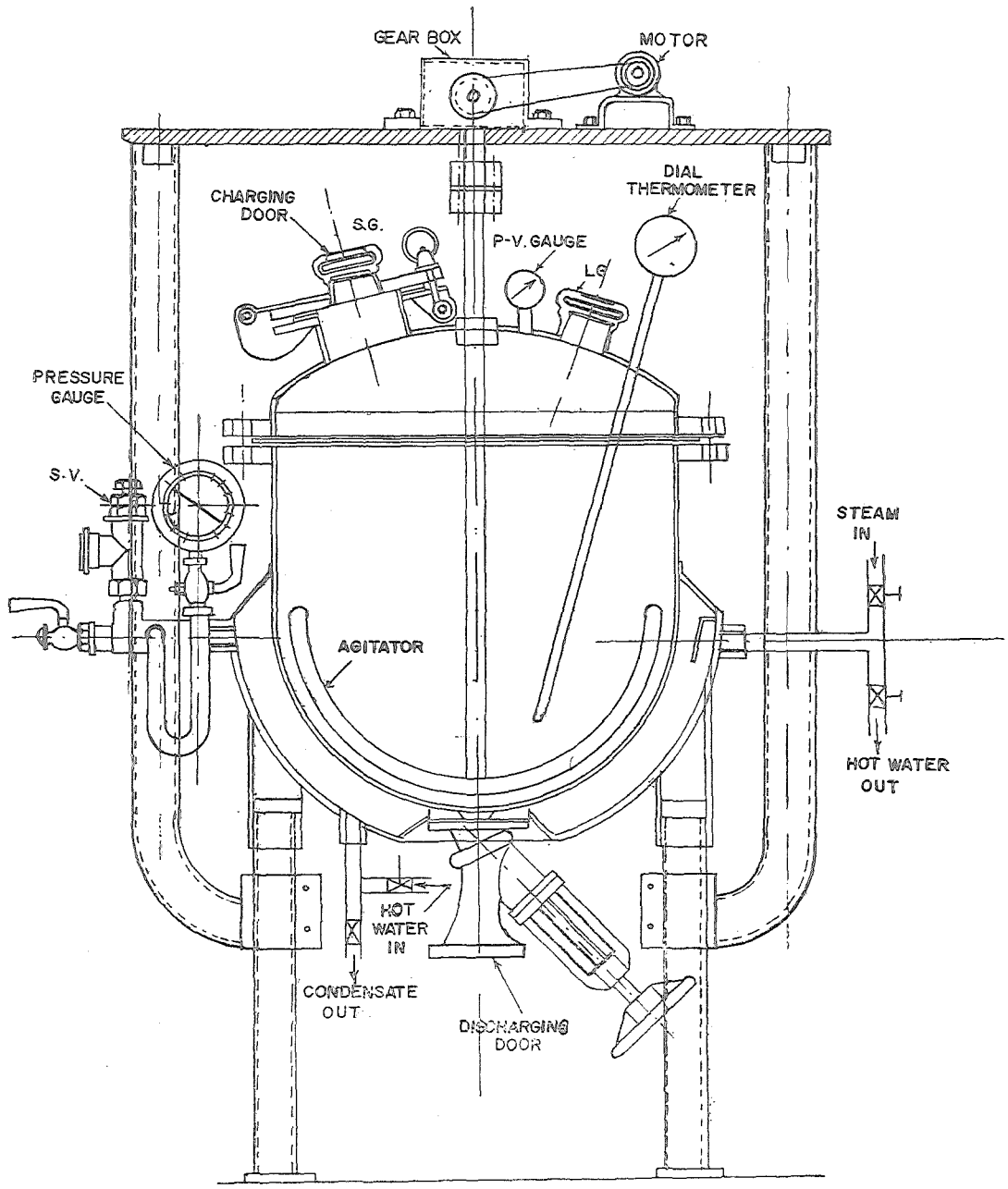
GEAR BOX
MOTOR
CHARGING DOOR
S.G.
P-V. GAUGE
LG
DIAL THERMOMETER
PRESSURE GAUGE
S.V.
STEAM IN
AGITATOR
HOT WATER OUT
HOT WATER IN
CONDENSATE OUT
DISCHARGING DOOR

FIG. 2

vii) Filtrate after final filtration in a plate and frame filter press is concentrated in the same vessel.

viii) If only fish hydrolysate such as bacteriological peptone is desired, the material is discharged from the vessel after concentration to 30% (solid) or more. If other products like beverage is desired, the ingredients as reported by Prabhu *et al.*, (1975) can be charged into the vessel at this stage and mixed well with the concentrated hydrolysate.

ix) Spent solvent obtained from step (ii) is charged into the vessel at the end of the process and pure solvent is recovered from it by evaporation and condensation.

The agitator is kept running throughout all these stages.

5. Hand operated screw press of capacity 50 litres — 1 No.

This equipment is used to press the solid mass obtained after cooking, solvent extraction and hydrolysis to remove the residual liquid which is not possible by simple filtration. Solid mass after initial filtration is taken out in a canvas bag and pressed under the press to remove liquid from the mass.

6. Stainless steel plate and frame filter press of size 300 mm. sq. plate - 1 No.

Filrate obtained from stage 4 (vi) is adjusted to the desired pH, heated to precipitate the coagulable proteins and is filtered in a plate and frame filter press using filter aid for efficient filtration. The filter press is a laboratory model plate and frame washable type, made out of stainless steel and having individual plate discharge arrangement, complete with a stainless steel centrifugal slurry pump, slurry storage tank, control valves and pressure gauge.

7. Drier — 1 No.

The concentrated hydrolysate obtained after stage 4 (viii) can be dried in any standard drier for liquid such as spray drier or vacuum roller drier or vacuum freezer drier. The dried product is packed in air tight container.

Conclusion

In the development of pilot plant set up for the production of fish hydrolysate efforts have been made to minimise the number of equipment. The most important of the set up is the design of multifunctional stainless steel reaction vessel. This equipment has not merely been used as a reactor for conducting enzymatic hydrolysis of fish protein but also for conducting other process steps like cooking, solvent extraction, removal of solvent from the extracted mass and recovery of solvent from the spent solvent, sterilization, mixing of ingredients and concentration of hydrolysate. This vessel can be operated under vacuum or under pressure at varying range of temperature while keeping the agitator running.

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