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THE FABRICATION OF AN HYDRAULIC JUICE PRESS**

Prepared by

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* Organized by UNIDO in co-operation with the Government of Zambia and the Village Industry Service

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INTRODUCTION

[illegible] subsidizing fertilizer, offering high producer [illegible] agro-related products. Such incentives [illegible] improved food processing equipment, as well as storage facilities to minimize [illegible]

1. Need for better storage facilities for processing foods

Studies conducted at the National Council for Scientific Research (NCSR) have indicated that storage conditions of processed foods play a major role in either enhancing or retarding of nutrient degradation. Vitamin C (ascorbic acid) in carbonated guava juice degraded from 35.1mg/100g to 2.8mg/100g, i.e. 90 per cent in 72 days when stored at room temperature (20-25°C) (i) results in a similar product by other scientists; (ii) indicate that there would be only five per cent degradation of the acid if the juice is stored at 0 to -5°C. Sophisticated equipment such as freeze driers have led to an even greater improvement in retarding degradation of nutrients. Pulp from guava was freeze-dried at NCSR laboratories. It was found that vitamin C had dropped from 225.28 to 222.64mg/100g, i.e. one per cent degradation in a [illegible] period as compared to 152.1mg/100g (32 per cent) for the pulp stored under room temperature (2).

2. [illegible] materials for equipment development

In Zambia, development of food processing equipment has been hampered [illegible] of suitable local construction materials. The most available materials are wood planks, mild steel and cast iron. Unfortunately, termites tend to attack wood unless it is treated. This, however, increases the cost of the materials and, consequently, of the equipment. Wood cannot withstand the high pressure involved in most food processes. In addition it tends to [illegible] water from juices, thereby making it [illegible]. The economic way to prevent this is to paint the wood so that it [illegible] more water resistant.

Cast iron or mild steel are not recommended for most food processing equipment since these materials are readily susceptible to rust and incapable of withstanding heavy loads (2). Stainless steel, which is not easy to find in Zambia, is recommended for fabricating food processing equipment.

Due to the lack of stainless steel, wood was selected for the fabrication of the juice press.

3. Effect of processing on nutrients in food

In most cases food processing results in losses in food nutrients. Results from experiments at the Food Technology Research Unit (FTRU) of the NCSR indicated a substantial loss in vitamin C in guavas (Psidium guajava) after processing them through a hammer mill. The results showed a greater loss of the vitamin in the flesh than in the peels. The loss was more pronounced in the processed flesh and peels than in the unprocessed parts after a 14-day storage period in the cold room at 0 to -5°C.

TABLE ONE

Deterioration of vitamin C in processed and unprocessed guava

Part of fruit	Vitamin C (mg/100g)			
	Before processing	After processing	processed* parts	unprocessed* parts
Peels	275.6	270.2	188.3	243.1
Flesh	189.0	171.4	10.5	36.7

* After 14 days of storage

JUSTIFICATION

The justifications for fabricating a fruit juice press include:

a. Low cost of fabrication

Materials used are locally available and do not need foreign exchange. The metals used (channels) were picked from our workshop yard thrown away as scrap metal.

b. Easy to operate

The equipment does not require specialized training to operate or even to maintain it. Its light weight makes transportation easier.

c. Cheaper than current methods of extraction

The current method of juice extraction from local fruits involves costs of clarifying agents, of filter aid and of electricity to run the filter press. See the process diagrams for the two different modes of juice extraction (figures 1 and 2).

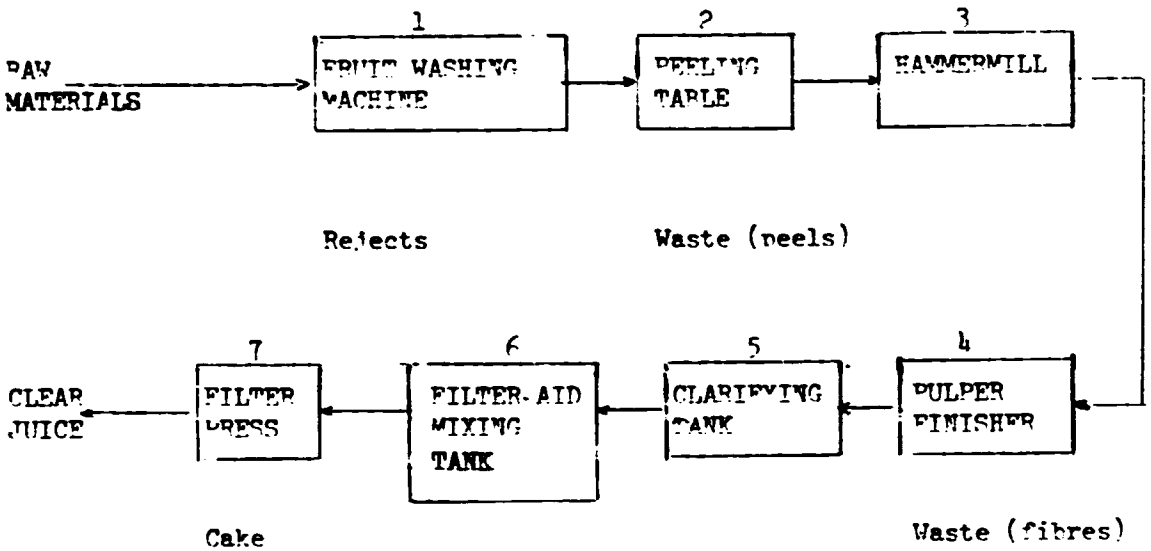


DIAGRAMME 1: CURRENT (EXISTING) PROCESSING STAGES

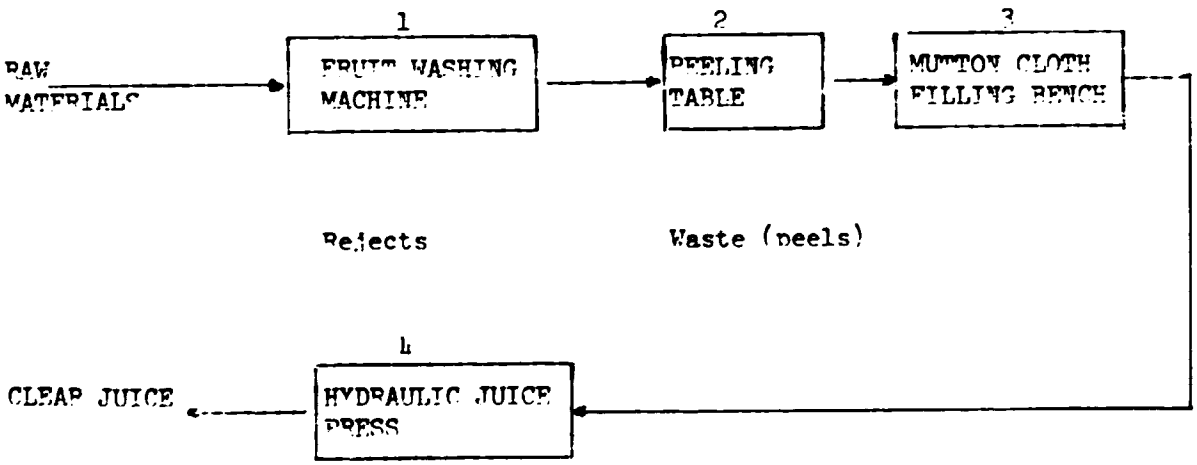


DIAGRAMME 2: MODIFIED (USING JUICE PRESS) PROCESSING STAGES

FABRICATION OF THE EQUIPMENT

From the design drawings, the hydraulic juice press (see drawing no. 1--A pictorial view of the press) was constructed. Timber bought from Zambia Forestry and Forest Industries Corporation (ZAFFICO) was used in making vertical and base supports, racks and the J-form. The cutting of the planks into required dimensions was done mostly in our Unit and partly by EW Tarry Zambia Limited. The dimensions of the used materials are found below:

Material	Thickness	Width	Diameter	Length
Vertical supports	5.1	10.2	-	91.6
Channels	5.1	10.2	-	45.7
Receiver	7.6	35.6	-	35.6
Receiver pipe	-	-	1.5	5.1
Racks	-	36.0	-	36.0
J-form	-	36.0	-	36.0
Guides	2.5	10.2	-	45.7

Two channels of mild steel were collected from the scrapyard behind our workshop. These were cut into the required dimensions and used as a press top and press base. Bolts (M12 x 200mm) secured the channels to the vertical supports.

Racks were made from planks (36cm long and 3.8cm wide). To allow the juice to flow down, the planks were placed 1.5cm apart (see photograph). The receiver was made from stainless steel by our workshop. A 5.1cm-long and 1.5cm-diameter stainless steel pipe was inserted into the hole made in the middle of the receiver.

The components were painted before assembling. The channels were painted with iron oxide primer to prevent rusting. Planks were painted with a white undercoat, then a pink primer and finally with a glossy white paint. The gloss white is widely used in food processing industries because it is nontoxic, acid resistant and impermeable to water.

TESTING OF EQUIPMENT

Fifteen pineapples bought from the Soweto market were divided into three batches. The fruits were peeled, sliced into small pieces and then covered in mutton cloth. The covered pieces were placed between the J-forms and, by using the hydraulic press, clear juice was extracted and collected from the receiver. The following results were obtained from the tests.

Whole fruit (kg)	Peeled fruit (kg)	Juice (kg)	Per cent juice extracted (kg)	
			Per whole fruit	Per peeled fruit
4.96	2.25	1.25	25.2	55.6
4.56	2.95	1.56	34.2	52.8
4.65	2.85	1.60	34.4	56.1

The average yield is 31.3 per cent juice per whole fruit or 54.8 per peeled fruit. The conventional methods used at NCSR (where clarifying agents have to be used) yield 44.6 per cent peeled fruit or 21.3 per cent per whole fruit.

OPTIMIZATION OF EQUIPMENT

Several parameters would be considered in optimizing the equipment to have the highest yield. One parameter considered was the particle size of the pineapple and its relation to the juice yield. The following results of the tests conducted on different sizes of the pineapple pieces are shown below.

Particle size	Juice yield (per cent)
4 x 4 x 4cm	58.4
*3 x 3 x 3cm	57.1
2 x 2 x 2cm	61.7

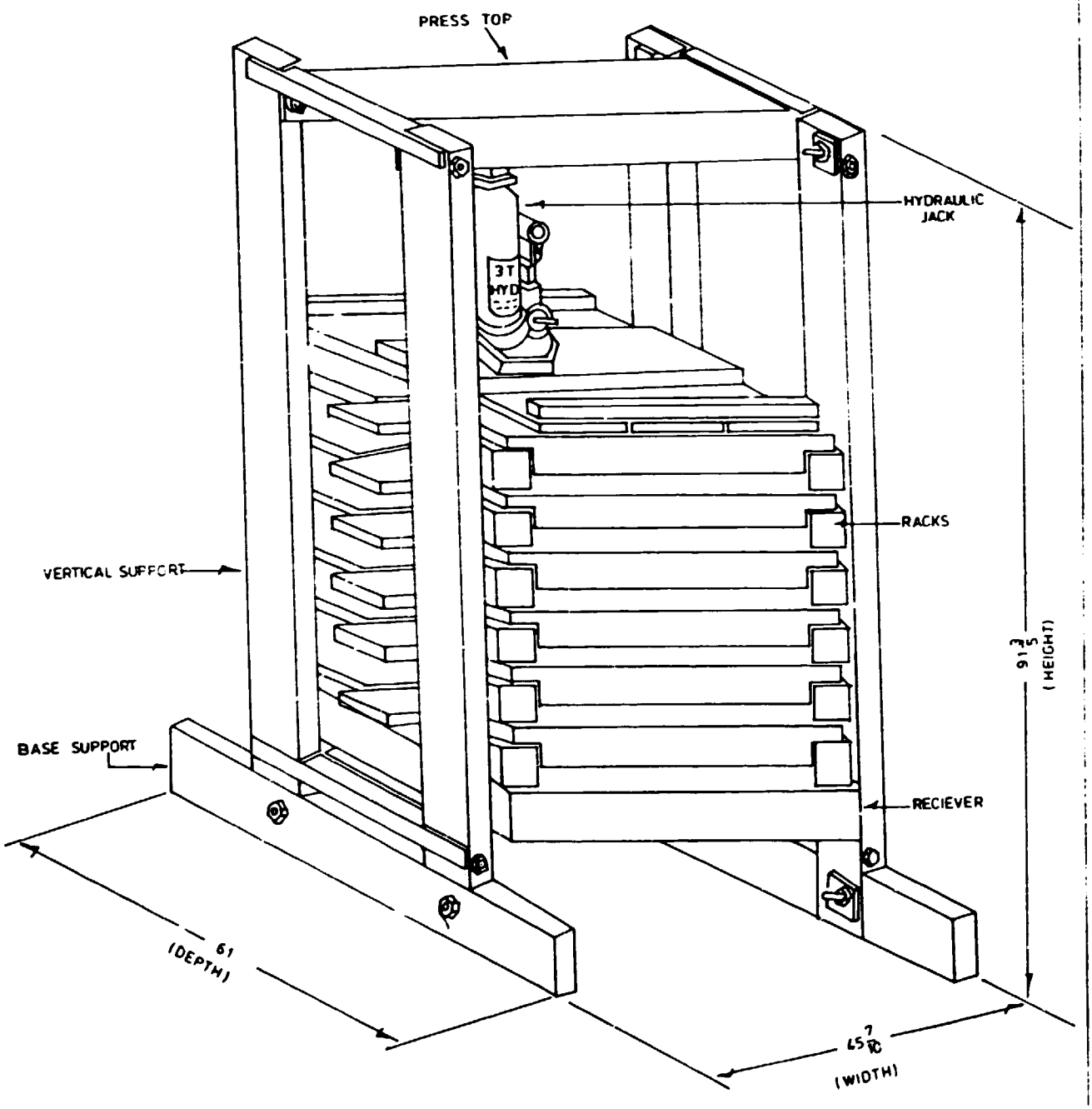
Most of the juice lost during processing was due to the improper use of the equipment.

CONCLUSION

The equipment performed better than the conventional methods of juice extraction. The hydraulic juice press yielded 54.8 per cent in comparison to 44.6 per cent for the conventional method.

In the optimization test, the results showed that the smaller the size, the more juice one expected to extract. This is no surprise since the surface area of extraction, i.e. cell walls on the piece, increases with the decrease in the piece size. However, there is a limit to which one can decrease the size after which it becomes impractical to handle. Thus, the size 2 x 2 x 2cm was easy to handle. It yielded the most juice and is, therefore, the recommended size.

Improvements are needed to decrease spoilage losses and increase the amount of fruits to be processed. More juice would be extracted if metals (stainless steel) were used to replace planks.



PICTORIAL VIEW OF A HYDRAULIC JUICE PRESS

DRAWING NO. 1

APPENDIX

	Materials	Cost (in Kwacha*)
1.	3-ton hydraulic jack	1559-48
2.	Planks	
3.	Paints (undercoat, gloss white, pink primer and iron oxide primer)	1117-75
4.	Bolts (mild metal)	540-00
5.	Channels (scrap metal)	850-00
6.	Stainless steel sheet (for receiver)	379-00
7.	Cutting of planks	3-72
	TOTAL	K4449-95
	LABOR	1500-00
	GRAND TOTAL	K5949-95

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* One US dollar = 10 Zambian kwacha

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