WINERY WASTE UTILISATION - A CASE STUDY OF DOWICO

BY

J. H. Y. KATIMA*

ABSTRACT

The Dodoma Winery Company (DOWICO), is presently processing about 1000 tonnes of grapes to produce different types of wines, with left overs of about 200 as wastes. These wastes are dumped outside the factory, obviously, a poor method of waste disposition as far as the environmental significance is concerned. Since the expansion programme to enable the plant to handle up to 30000 tonnes of grapes per year is in the pipeline the best method of disposing the huge amount of waste (about 6000 tonnes) that will of waste (about 6000 tonnes) tht will result, has to be sought.

This paper highlights the financial and sanitary advantage of making the fullest sanitary advantage of making the fullest use of the winery waste by producing drinkable alcohol, Potassium Tartrate, Edible oil, Nutritious animal feed and fertilizer as by-products. The technology involved is not sophisticated, moreover, most of the equipments involved can be manufactured locally. The experimental results are presented.

1.0 INTRODUCTION

The words "waste materials" in environmental control vernacular, generally mean those materials that are discarded other than as pollutants in the waste waters or in emissions to the atmosphere. Waste materials may be solids, liquids, semisolids, slurries or

even contained gases. Much of the industrial waste is similar to household garbage and refuse as far as environmental significance is concerned. One interest, ofcourse, is simply aesthetic.

Some industrial waste could be harzadous to humans or other organisms if not properly disposed of. Otherwise, if left open and unprotected such material will breed flies, rats and orders. In a dump or landfill a certain amount of liquid will ordinarilly drain from the material. This drainage (leachate) can seriously degrade the quality of groudwater or surface waters it might reach. Degradation of the organic matter may produce slightly acidic conditions in the leachate that will tend to dissolve metals that may be present.

Thus, whenever possible, reuse of the waste or secondary uses rather than their disposal is of great financial and sanitary advantage.

There are three major wastes from a winery industry, viz:

(i) POMACE :- Is the residue obtained after crushing grapes and separating the grape juice (MUST). It consists of skins, seeds, pulp and small amount of juice, and constitute about 16 - 20% w/w of the grape fruit (see table 1, appendix).

(ii) LEES:- Is the undrinkable thick matter (sediment) that remain at the bottom of the wine tank. For every kilogram of grape processed about 14.4 - 15.6 ml of lees can be obtained (see table 1, appendix).

(iii) These are smaller parts which supports the grape on a vine tree.

Presently, these wastes, which accumulates at a rate of about 200 tonnes per year, are dumped outside the factory and left there to rot. Although the expansion programme, which will enable the plant to handle up to 30000 tonnes of grapes annually is nearing the implimentation state (2), no body has given thought on the best method of disposing the huge amount of waste that will result.

The present mode of disposition will definitely cause an environmental havoc and thus a better method should be sought. Fourtunately, all the three constituents of winery wastes can be completely used to produce by-products of high economical value. Experiments as well as literature have revealed that.

2.0 EXPERIMENTAL RESULTS.

2.1 Pomace and Lees as sources of Ethanol

(i) Straight from the pressing machine after separating the must, for the processing of white wines. Thus, have to be fermented
prior distillation.

(ii) From red wine tanks. It is worth mentioning that the difference between the red and white wine is the presence of pigments known as "anthocynanins" and "tannins" in red wines. These pigments are responcible for colour and organoleptic character of the wine, and are found in the skins of the plack grapes. Therefore, during red wine production the pomace is fermented together with the must (1,2,4).

The less was taken from the wine tanks.

The fractional distillationw as done on the laboratory scale and the results are presented in table 2(a) and 2(b), appendix. It can be seen that, on average, one kilogram of pomace yields 156 ml of approximately 32% w/w alcohol, while 1 l of lees gives 219 ml of approximately 34% w/w alcohol. The physical properties of ethanol obtained are as follows.

Viscosity kg/ms		Density kg/m^3	
Experimental	Theoretical (8)	Experimental	Theoretical (8)
$3.00 * 10^{-3}$	$2.74 * 10^{-3}$	948	950.4

It is worth mentioning that the distillation temperature should not exceed 82°C, since above this temperature the concentration of acids, esters and aldehydes in the distillates, which are undesirable, increases (1).

2.2 Grape seeds as a source of edible oil

A known weight of pomace, on dry basis, was soaked in water to ease out separation of seeds from the skins. The separation was done by forcing the seeds out of the skins by hand (however on large scale application other means such as agitation of the soaked pomace may be used). The results are shown in table 3, appendix. It was found that, on average, 1 kg of pomace can give 0.28 kg of seeds.

The seeds were crushed and the oil was solvent extracted by using the soxhlet extractor and n-hexane as a solvent, the results are

shown in table 4, appendix. It can be seen that the seed-oil content is about 14.5% w/w.

The physical properties of the grape-seed-oil were found, experimentally, to be as follows:

	Experimental	From ref. 6
Viscosity at 25°C, kg/ms	$2.58 * 10^{-3}$	-
Density at 25°C, kg/m	923	-
Iodine number	124	124 - 143
Saponification number	190	178 - 196

The oil composition was found to be:

Linoleic acid, %	70	45 - 72
Oleic acid, %	15.3	12 - 33
Saturated acids, %	14	-
Unsaponifiable matter, %	0.7	0.3 - 1.6

2.3 Pomace and Lees as sources of Potassium Tartrate

Tartrate, which is mainly used to manufacture tartaric acid and pharmaceuticals, occur naturally in winery pomace, still slops for brandy distillation, in lees and in wine storage tanks (1,4). The principal compound being potassium Bitartrate. Extraction of tartrate was accomplished by hot water since the cream of tartar is very soluble in water (in large scale operations acidified water should be used) (3,6). It was found that the tartrate in pomace and lees is about 0.7% w/w.

2.4 Winery waste as a source of Tannin

Tannin, which is mainly used in leather industries, and in the manufacture of dyes and ink, is present in pomace, lees and stems

(1.4). Tannin was extracted by using acetone (ethanol can also be used (3,6). it was found that the tannin content is about 0.4% w/w.

2.5 Winery waste as a source of Fertilizer.

Jacob and Proebstring in 1937 (1), found that the winery wastes have about the same ultimate fertilizing value as barn yard manure, although it becomes available more slowly. They reported the presence of 1.5 - 2.5% w/w Nitrogen, 0.5% w/w Phosphorous and 1.5 - 2.5% w/w Potassium (on dry basis). On application of these wastes, they found that the soil texture improved physically for the heavy soils. However, heavy application could create temporary toxic condition in the soil and sometimes kills the plants.

2.6 Winery wastes as stock Feed

The wastes can be dehydrate to low moisture content and ground for use as animal feed, particularly daily cows. However, because of high crude fibre content they should be used as supplimental feed only.

3.0 DISCUSSION

From the above results, based on the envisaged 30000 tonnes of grapes per year, the Company expects about 5400 tonnes of pomace and 450 tonnes of lees.s From which about $8*10^{-5}$ l of 32% w/w and $9*10^{4}$ l of 34% w/w alcohol respectively could be obtained. Based on the x-factory price of fine spirits (i.e. T.Sh. 100/= per litre (7)) the Company could recover about T.sh. 89 m per year.

Also the company could produce about 200 tonnes of oil from the envisaged 1500 tonnes of grape seeds. The composition of which,

suggests its possible use as salad and cooking oil (6). Can be used in soap making too. Assuming that the price of a kilogram of this oil will cost T.sh. 110/=, (about the price of the imPorted cooking oil), the company will realise about Tsh. 22 m per year.

Other components, i.e. Tannin and Tartrate, though seem to be present in low quantities, could be economically extracted and used (about 42 tonnes of tartrate and 23 tornes of tannin could be realised).

The company plans to have its own vine year farms, thence the fertilizing value of these wastes could be use in these farms.

Dodoma is a semiarid region, at times there is no enough grass to feed the live stock, thus the market of stock feed is certain.

4.0 CONCLUSION

It is now apparent that a secondary use of the winery waste is of financial and sanitary advantage. If the expansion programme will materialise the Company, definitely, will have to abandon the present mode of waste disposal. And the best alternative method will be to make the fullest use of these wastes.

5.0 REFERENCES

1. AMERINE, M.A. et al: "The Technology of Winemaking", 1974.

2. DOWICO : Ladger and Record Books.

3. FRITZ & SCHEAK : "Quantitative Analytica Chemistry", 1969.

4. GOULD, R.F.: "The Chemistry of Wineamking", American Chemical Society, 1976.

5. SHUGAR, B. : "Chemical Technicians' Ready Handbook", McGraw Hill, 1981.

6. SWERN, D. : "Bailey's Industrial Oil and Fat Products", 4th edn. vol 1, John Wiley & Sons, 1979.

7. TANZANIA DISTILLARIES LTD. : Private communication.

8. WEAST, R.C.: "CRC Handbook of Chemistry and Physics", 58th edn. CRC Press, 199999978.

6.0 ACKNOWLEDGEMENT

I greatly honour the help I got from the DOWICO.

EAFPER
T1
.U32

7.0 APPENDIX

Table 1:- Production data (2)

Amount of grapes	Romace obtained	Wine produced	Lees obtained	Date of processing
kg	kg	l	l	
11000	1980	8855	185	12/2/80
12450	2250	10010	190	12/6/81
9000	1620	7250	180	12/12/81
13750	2478	11068	207	2/7/82
15000	2700	12075	225	16/11/82
20000	3600	16100	300	21/4/83
9000	1600	7280	140	12/2/84
10000	1800	8050	150	10/12/84
8000	1440	6450	120	13/3/85

Table 2(a) :- Alcohol From Pomace

Pomace

Quantity	Distillation temperature	Amount of alcohol	Concentration
g	c	ml	%
300	80.0	47	32.5
500	79.0	71	32.0
250	79.0	38	32.0
360	80.0	56	31.0
100	82.0	15	32.0
200	80.0	36	30.0
360	81.0	59	32.0
350	80.0	54	32.0
200	81.0	33	30.0
300	80.0	45	33.0

Table 2(b) :- Alcohol from Lees

Quantity	Distillation temperature	Lees Amount of alcohol	Concentration
ml	C	ml	%
200	80.0	44	36.0
150	80.0	33	36.0
220	82.0	46	35.0
200	79.5	43	33.0
160	79.5	35	33.0
200	80.0	42	30.0
220	80.0	48	32.0
180	81.0	41	31.0
100	82.0	22	32.0
150	83.0	31	31.0

Table 3:- Seeds From Pomace

wt of pomace	Drying period	wt of seeds
kg	hr	kg
1.0	8	0.282
2.0	8	0.560
1.0	8	0.418
0.5	8	0.140

Table 4:- Seed - Oil - Content

wt of seeds	n-hexane	number of refluxes	wt of oil
g	1		g
400	1.5	3	58.0
400	1.5	4	57.5
200	1.5	5	29.0

*Assistant Lecturer, Chemical and Process Engineering Department, University of Dar es Salaam.