Alcohol Content of Traditional Brews and *Miti ni Dawa* in Kenya

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A number of alcoholic preparations sold in Kenya were analysed for their alcohol content. The alcohol content for various samples varied over a wide range. In the legal beers it ranged between 3.8 to 7.4% volume parts. Busaa had an alcohol content between 2 and 7.5 for Muratina it was 2.1 - 9 %, Miti ni Dawa 1.2 - 8.4% and Changaa 16.2 - 31.5%. A sample of Miti ni dawa and changaa were found to contain trace amounts of methanol possibly a result of hydrolysis of methoxy groups in pectins. Fermentation temperature was found to be an important determinant of the final alcoholic content in Miti ni Dawa.

Key Words: Kenya, traditional, other brews, alcohol content

INTRODUCTION

Traditional alcoholic beverages are widely used in Kenya during socio-cultural ceremonies such as marriages, initiation to adulthood, funerals and sacrificial ceremonies to appease ancestral spirits or after breaking taboos. The manufacture and drinking of these beverages is not illegal but the Government uses indirect, extra-judicial means to minimise their indiscriminate use which it associates with lawlessness and idleness, especially among the youth and the unemployed urban dwellers. Under the Chiefs Act, the administration often require those who wish to manufacture the traditional alcoholic brew to apply for a permit stating the significance and date of the ceremony for which the traditional brew will be used.

All the traditional alcoholic beverages in Kenya are derived from natural fermentation of carbohydrates. Common raw materials include commercial sugar, jaggery sugar, juice extracted from sugar canes, honey, ripened bananas, and maize meal. Often it is the spoiled maize, invariably contaminated with aflatoxins, that is used. The actual fermentation process is considered an art and in any given society a few individuals recognised as experts are called upon to assist whenever the need arises.

Traditional alcoholic beverages fall into 2 broad categories. The first category is made of those beverages derived from natural fermentation of carbohydrates without being subjected to distillation process (group I). The second category include those derived from natural fermentation of carbohydrates but in addition, some distillation has taken place to raise the ethanol (alcohol) content to above 14% and therefore make them more potent (group II). As expected the traditional alcoholic brews are known by various local names. Muratina and Busaa are common names for group I while Chang'aa is a common name for group II beverages.

More recently a third category has emerged. This is the medicinal herbs decoction to which honey has been added and fermentation allowed to proceed naturally for a specified period. This preparation has acquired the Swahili baptismal name of 'Miti ni Dawa' which in English roughly translates as 'herbs are medicines'.

There is an ongoing controversy regarding the therapeutic value of Miti ni Dawa with protagonists arguing that it is an alcoholic beverage while the proponents argue that it is very effective in treatment of such conditions as gout, poor appetite, muscle atrophy and general malaise. The ingredients used to prepare Miti ni Dawa vary considerably and even the manufacturing processes lack uniformity. *Strychnos* and *Fagara* species are common ingredients. There is no recommended dose as would be expected of a medicine.

In the present work, the authors collected samples of group I and II alcoholic beverages as well as Miti ni Dawa and analyzed them for alcohol content using Gas Liquid Chromatography (GLC). Samples of commercial beers were purchased from local supermarkets and used for reference purpose. In addition samples of group I and II alcoholic beverages and Miti ni Dawa were chemically screened for additives using ultra-violet (UV) spectrophotometry. Examination of samples for additives was considered of interest since it is known that some unscrupulous brewers add such substances as quinine, diazepam and generally other bitter substances.

MATERIALS AND METHOD

Samples

Analytical grade absolute ethanol (Riedel - de Haen, Germany) and High Pressure Liquid Chromatography (HPLC) grade methanol (Rathburn Chemicals, Walkerburn, Scotland, UK) were used as reference materials.

Miti ni dawa samples were purchased from various localities of Nairobi, from Nakuru and one each from Narok and Uganda. The local brews Busaa, Muratina and Chang'aa (Nubian gin) were purchased in the surburbs of Nairobi. Legal beers were purchased from Supermarket outlets.

Instrumentation

Samples were analysed using a Delsi 200 gas chromatograph (Nermag, France) equipped with a flame

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ionisation detector and 1.5 x 0.25" O.D column packed with chromapack Q (Bio-rad RSL N.V. Belgium). The chromatograph was coupled to a Hewlett Packard 3396 series II integrating recorder (Avondale, PA, USA). Carrier gas was nitrogen set at a flow rate of 30 ml/min. The column temperature was set at 125^{0}C, injector at 220^{0}C and detector at 200^{0}C.

Ultraviolet spectrophotometry (UV) screening of the samples was done using a Philips model 8750 spectrophotometer (Philips Analytical, Cambridge, U.K).

Sample preparation for chromatography

Standard ethanol was diluted 10 times and 1.0 ml of the solution diluted to 100 ml to give a concentration of 0.1% v/v concentration. This was used as the daily working standard. Undistilled brews and Miti ni Dawa were filtered through a 0.45 µm membrane filter and, where necessary, suitably diluted before chromatography. Changaa and beers were diluted and chromatographed.

Sample preparation for UV

Undistilled brews and Miti ni Dawa were filtered through a 0.45 µm membrane filter and, where necessary, suitably diluted before obtaining a spectrum. Changaa and beers were used without dilution.

RESULTS

The gas chromatographic method used in the analysis was found applicable to all types of brews. The quality of separations obtained remained unchanged during the investigation period and no peak interference was detected. A typical chromatogram of a Changaa sample showing the separation between ethanol and methanol is shown in figure 1.

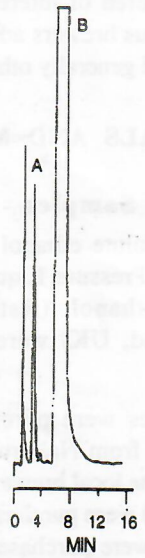

Fig 1 : A chromatogram of a changaa sample showing the separation and presence of methanol peaks
A - Methanol, B - Ethanol
Chromatographic conditions are as described in the text.

Linearity of the method

The linearity of the method was checked using a six-point calibration curve. Concentrations of ethanol were 0.0125, 0.025, 0.0375, 0.05, 0.075 and 0.1% volume parts ethanol. The concentration versus response gave a correlation coefficient of 0.9993.

Results of the analyses for group I alcoholic beverages are summarised in Table I. The Muratina samples (column 1) gave an alcohol content of between 2.1% v/v for Mathare and 9 % v/v for Kangemi with a mean of 5.1% v/v. The alcohol content of twelve Busaa samples (column 2) range between 2 and 7.5% v/v for samples obtained from Kibera and Kariobangi respectively, with a mean of 5.3%.

Table 1 also shows the alcohol content of 14 samples of Miti ni Dawa the popular local "medicinal" herbal decoction. The alcohol content ranges from 1.2 to 8.4% with a mean value of 4.8%. A sample from Kawangware was found to contain 0.03% v/v methanol.

TABLE 1 : The ethanol content (%v/v) of alcoholic brews from various localities of Nairobi

Source	Muratina	Busaa	Miti ni Dawa
Dagoretti corner	4.4	3.6	8.4
Dandora	3.4	6.3	-
Embakasi	4.0	4.9	1.8
Kangemi	9.0	5.7	3.5
Kariobangi	2.0	7.5	5.3
Kawangware	4.5	3.7	7.8[a]
Kibera	7.2	2.0	6.1
Lindi	7.7	-	-
Mathare	2.1	6.3	6.1
Ngomongo	6.7	-	-
Ngurogon	3.4	-	3.8
Soweto	5.5	-	-
Ruaraka	7.5	5.9	-
South B	6.1	5.3	-
Kajiado Town	-	-	7.4
Nairobi[b]	-	-	3.8
Nairobi[b]	-	-	6.3
Nakuru	-	-	3.7
Nakuru[c]	-	-	2.0
Nakuru[c]	-	-	1.2
Nakuru[c]	-	-	3.0
Uganda	-	-	3.9

a Had traces of methanol (0.03%)
b Samples submitted by herbalists to our laboratory
c Municipal Council

Table 2 shows the ethanol content of legal beers. The values for beers from Kenya Breweries Ltd were within their specifications (personal communication). Guiness with 7.4% volume parts ethanol is the strongest beer and Tusker export with 3.8% alcohol the most mild. Kenwine had 5.8% alcohol. Two samples of Chibuku had respectively 4.4 and 5.2% alcohol while those for Nyuki had 4.0 and 5.1 % alcohol.

TABLE 2 : The ethanol of local legal brews available in Nairobi

Source	Ethanol % V/V
Tusker Export	3.8
Guiness	7.4
Kenwine	5.8
White Cap	4.6
Tusker Premium	5.2
Pilsner	4.9
Kenbrew	5.2
Tusker	4.3
Nyuki	5.1
Nyuki	4.0
Chibuku	4.4
Chihuhi	5.2

Table 3 shows the ethanol content of 12 Chang'aa samples (group II) which as stated earlier have been subjected to some form of non-specific distillation process. The alcohol content range from 16.2 to 31.5% with a mean of 21.7%. A changaa sample from mashimoni was found to contain methanol at a level of 0.23% volume parts.

TABLE 3 : The ethanol content of Chang'aa from various localities of Nairobi

Source	Ethanol % V/V
Dagoretti	16.2
Dandora	20.9
Embakasi	24.9
Kangemi	21.9
Kariobangi	20.3
Kawangware	17.6
Laini Saba	27.4
Mashimoni	31.5
Mathare	20.9
Ngomongo	17.3
Ruaraka	17.1
South B	24.2

[a]Had traces of methanol (0.23%)

Further investigation of Miti ni Dawa

The range of alcohol content of Miti ni Dawa prompted us to investigate the fermentation process further. At least for two samples, the alcohol content was found to change when analysed on three consecutive days.

To carry out this supplementary investigation, a freshly prepared sample of Miti ni Dawa was purchased and analysed the same day. It was then divided into 4 parts and put in glass bottles with tight rubber lined srew caps. The samples were placed at various temperatures. The fermentation progress was followed by determining the alcohol content daily for 7 days, then on day 10. The results are presented graphically in figure 2.

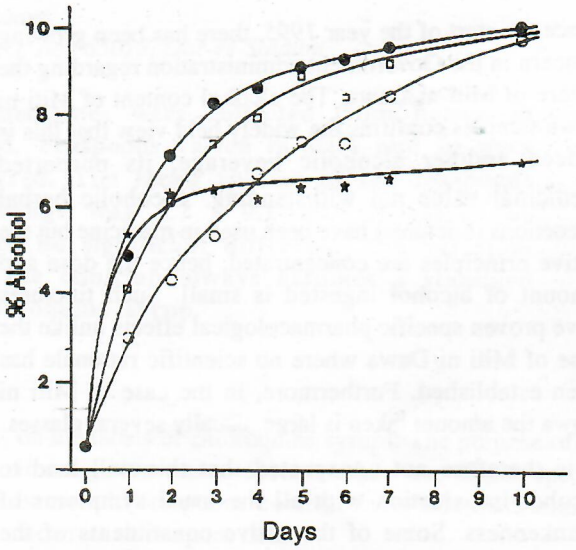

Fig. 2 : A graphical presentation of the fermentation process in *Miti ni Dawa*, over a 10-day period

Alcohol content at the following temperatures:
22°C 30°C 37°C 45°C

There was an increase in the alcohol content in all samples. By day 10, the alcohol content was 9.58% at room temperature, 9.88 % at 30 ^{0}C and 9.92% at 37^{0}C. The sample placed at 45^{0}C, gave an alcohol content of 5.36% on day 2, but thereafther increased slowly to about 6.96% on day 10. The latter result probably indicates an optimum temperature above which the fermentation is adversely affected.

DISCUSSION

Alcoholic fermentation, basically anaerobic metabolism of glucose by yeast, is well documented in standard text books of biochemistry [1] and no attempt is made to discuss it here.

Natural fermentation of carbohydrates to produce ethanol is self-limiting and stops when the ethanol content reaches a maximum of approximately 10 - *15%* v/v, and kills the yeast cells. In the case of Japanese beer sake, produced from steamed rice, a strain of yeast *saccharomyces sake* continues to produce ethanol in concentration of up to 17 - 18% v/v. Usually the major determinant of final alcohol content is the amount of sugar available in the mixture. Results in Table 1 are generally consistent with this fact and confirm that samples of Busaa, Muratina and Miti ni Dawa analysed were indeed the product of natural fermentation, not subjected to a distillation process. This is in sharp contrast to results shown in table 2 where the ethanol content of the distillate product Changaa is well above that expected from natural fermentation. Whereas Busaa

and Muratina are sold in *0.5* litre bottles or large glasses, Changaa is sold in small amounts (tots) of 10-20 ml. Approximately 90% of those who succumb to alcohol intoxication and are taken to hospital in a coma are Changaa drinkers.

Since the start of the year *1995*, there has been growing concern in the Government administration regarding the nature of Miti ni Dawa. The alcohol content of Miti ni dawa samples confirms the widely held view that this is indeed another alcoholic beverage, its purported medicinal value not withstanding. Alcoholic herbal decoctions (tinctures) have been used in medicine but the active principles are concentrated, hence the dose and amount of alcohol ingested is small. Such tinctures have proven specific pharmacological effects unlike the case of Miti ni Dawa where no scientific rationale has been established. Furthermore, in the case of Miti ni Dawa the amount taken is large, usually several glasses.

It is therefore not unexpected that this will lead to alcohol intoxication with all the usual symptoms of drunkenness. Some of the active constituents of the herbs used to prepare Miti ni Dawa may be toxic. For example pyrrolizidine alkaloids, associated with Venous Occlusive Disease (VOD) are present in some of the medicinal herbs.

The alcohol content of Changaa ranges between 16.2 to 31.5% v/v. This wide variation could arise if the Busaa from which they are distilled are at different degrees of fermentation, or the distillate is diluted with water as occasionally claimed.

However, be it Busaa, Muratina, Chang'aa or Miti ni Dawa, the amount that is required for intoxication depend on the locality where the product is purchased and perhaps on the batch. This makes it more difficult to estimate and regulate the alcohol intake of such preparations. This and presence of methanol are enough reasons for the Government to discourage the preparation and use of local alcoholic drinks.

In the present work, no UV active drug was detected in the traditional brews or Miti ni Dawa. However all samples, except those of Changaa, had UV absorbing compounds since they are plant preparations. No attempt was made to screen for inorganic substances.

Presence of methanol in Miti ni Dawa and Changaa is worrying, whether deliberately added or otherwise in view of its toxicity. Production of methanol from methoxy groups in pectins has been documented [2]. Changaa laced with methanol has caused several deaths in Kenya (Personal communication with the Government Chemist Department, Nairobi). In August 1998, several people in Narok and Kiambu died after drinking methanol-contaminated traditional brew. Many other became permanently blind. In nearly all such cases, the offending methanol, has been obtained through theft apparently being mistaken for rectified spirit. Some traditional brews are said to contain formadlehyde, commonly used as an embalming agent.

The legal beers are well regulated in terms of alcohol content which is perhaps the basis of brands for products from Kenya Breweries Ltd. Differences in the batches of Chibuku Nyuki may be due to incomplete development and validation of production.

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