

## DETERMINING THE CONCENTRATION OF ALCOHOL FROM THE NATURAL DISTILLATES

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**Key words:** *distillates, ethanol concentration, pycnometer*

### INTRODUCTION

Ethanol, the eldest drug, has been constantly used, ever since the beginning of civilization. It has been used as an aliment, as medicine, with religious and social purposes. The first scientific studies regarding the making of alcohol by the ferment of saccharine liquids are performed in the XVII century. Thanks to the contribution of Fabroni, Thenard, Appert, Gay - Lussac, Cagniard de Latour, Schwan, Turpin, Liebig and Pasteur, the vinous fermentation process is totally elucidated in the XIX century when alcohol begins to be industrially made.

The first mentioning about the making of brandy on the Romanian territory dates since 1570 (and it refers to Turt from Satu Mare).

Brandy is an alcoholic drink obtained by the distillation of fermented fruits in general and of plums in particular. The name "țuică" that the brandy has is unique and specific to our country, that is why it is considered to be a national drink. Being included in the category of natural brandies, "țuică" is obtained by fruit distillation – plums, apples, pears, cherries, morello, fruit mixture (cherry plums, apricots, peaches, gubbins, strawberries, wild strawberries, blueberries, and cranberries), from wine or wine distillates, from the yeast that remained after the mash settled or from wine and it has alcoholic concentrations from 24% to 55% (for "palinca") [1], [2], [3], [4].

### MATERIAL AND METHODS

The natural distillates that were studied, have been taken from Moldavia between 2007 and 2008. The 98 samples represent products that resulted after the distillation of the mixture of fruit maceration extract (apples, pears, plums, grapes), simple plum or grape maceration extracts (marc). These distillates are found all around the area, the recipes that are used are personal and thus they have a traditional character.

The samples proved to be settled, clear and without any slurry at the organoleptic test, with a specific smell of alcohol and the characteristic flavour of the material from which the sample was distillate. It was noticed from the collected data that the sample had no adjuvant or flavour enhancers and no artificial colouring. Also, these distillates contain neither sugar or other sweeteners nor extracts that might influence their density. Having in mind this thing, according to the methodological standards emitted by the Romanian Institute for Standardization, and considering the recommendations of the EEC Regulation nr. 2870/2000 and depending on the laboratory analysis equipment, it was chosen to determine the real alcoholic concentration in volumes using the pycnometry method. This method is checked and certified both with the Romanian legislation and the European Union [5], [6], [7], [8], [9].

The principle method – measuring the density of the distillate using pycnometry.

Reagents and materials - distilled water

Equipment manufacturers:

- Analytical balance that allows weighing 0,1g (calibrated and certified).
- Pyrex glass pycnometer with a capacity of 100 or 50 mL equipped with a removable thermometer (ISO 3507). In this case a 50 mL thermometer was used. The thermometer is calibrated in tenths of degree from 10 to 30 degree Celsius.
- Thermal insulation jacket that fits the thermometer.

Procedure

#### a. Calibrating the pycnometer

The clean and dried pycnometer is introduced in the thermostat for 30 minutes at 20°C, then with the help of the analytical balance the mass value of the pycnometer is weight.

G1 – 39,8410 - the mass of the empty pycnometer

*b. Determining the annual water*

The annual water stands for the weight of the distilled water at +20°C which is continue until the scale mark in the pycnometer closed with its stopper. Determining this coefficient is done at minimum 20 determinations when it is continually kept at the same temperature of +20°C [2], [3].

This way the pycnometer is filled with distilled water at +20°C so there won't be any bubbles on the inside part of the pycnometer, on the outside it is wiped and it is put into the thermostat for 30 minutes at +20°C. The pycnometer is weight at the analytical balance. There were two measurements done and the used value was the mean of the two masses that were obtained.

Thus we have:

g I = 89,6634 – the mass of the distilled water pycnometer – first weigh

g II = 89,6636 – the mass of the distilled water pycnometer – second weigh

The difference between the two weighs is of 0,0002, which fits the standards, and thus the average value is of 89,6635.

G2 = 89,6635 - the mass of the pycnometer filled with water at +20°C

The annual water is given by the difference between the mass of the pycnometer with water and the empty pycnometer, according to the formula:

$G = G2 - G1$        $G = 89,6635 - 39,8410$   
G – the annual water

This value of 49,8225 was used to calculate the relative density of the distillate samples from sample number 1 to sample number 21. The annual water was determined in the same manner for the rest of the samples by dividing their number to 4.

*c. Determining the relative density*

For the determination of the relative density of the distillates, each sample was weighed in the pycnometer at constant temperature. This was done by keeping the samples and the pycnometer at +20°C for 30 minutes. A constant temperature was maintained and a thermal insulation jacket was used.

The masses obtained for each sample together with the pycnometer are presented in table 1.

The relative density of the distillates at +20°C related with water at +20°C was calculated according to the formula:

$$P20/20 = (G3 - G1) : G$$

P20/20 – the relative density at +20°C related with water at +20°C;

G – the value of the annual water

G1 – the mass of the empty pycnometer

G3 – the mass of the pycnometer and the sample

*d. Determining the real relative density*

It was necessary to calculate the value of the real relative density, which is the value of the relative density of the samples at +20°C with water at +4°C. The formula allows to determine the real relative density and the air density at +20°C with water at +4°C.

$$P20/4 = (0,99823 - 0,00120) P20/20 + 0,00120 = 0,99703 \times P20/20 + 0,00120;$$

P20/4 – relative density at +20°C and water at +4 °C;

P20/20 – relative density at +20°C with water at +20°C

0,99823 – water density at +20°C with water at +4°C;

0,00120 – air density with water at +4°C.

*e. The alcoholic concentration*

The value obtained for the real relative density P20/4 of probes for distillation are reported in tables approved by the World Organisation of Legal Metrology, from which on obtain the value of ethylic alcohol in weight percentage (table 1). Based on the alcoholic concentration in weight percents on obtain the real concentration in volume percentage (table 1) according with the international tables that are found both in the Romanian STAS and legislation as well as in The Recommendation 22 of O.M.M.L. [6].

## RESULTS AND DISCUSSIONS

The resulted values for the real relative density P20/4 of the distillate samples are related to the tables that are approved by World Organization of Legal Metrology from which the values of the alcohol concentration from the distillates in weight percentages are obtained. (table 1). Based on the alcoholic concentration in weight percentages the real concentration in volume percentages is obtained (table 1) according to the international tables that are found in the STAS sites and the Romanian legislation and in the 22 Recommendations of the OMML [7], [8], [9].

Table 1. Determining the ethanol concentration in natural distillates samples using pycnometry

| No | Source of the sample | Characteristics       | Annual water | The mass of the pycnometer with the product in g. | Relative density P20/20 | Relative density P20/4 | C% in weight percentages | %C in volume percentages |
|----|----------------------|-----------------------|--------------|---|-------------------------|------------------------|--------------------------|--------------------------|
| 1  | Mărgineni Bacau      | Marc                  | 49,8225      | 85,8595   | 0,9326                  | 0,9220                 | 46,84                    | 54,6                     |
| 2  | Mărgineni Bacau      | Marc                  | 49,8225      | 87,2691   | 0,9519                  | 0,9502                 | 32,12                    | 38,6                     |
| 3  | Mărgineni Bacau      | Marc                  | 49,8225      | 87,4229   | 0,9550                  | 0,9533                 | 30,32                    | 36,5                     |
| 4  | Lipova Bacau         | Marc                  | 49,8225      | 87,3618   | 0,9538                  | 0,9521                 | 31,03                    | 37,4                     |
| 5  | Racova Bacau         | Marc                  | 49,8225      | 86,5689   | 0,9378                  | 0,9362                 | 39,53                    | 46,8                     |
| 6  | Racova Bacau         | Marc                  | 49,8225      | 88,1900   | 0,9704                  | 0,9687                 | 20,08                    | 24,6                     |
| 7  | Blăgești Bacau       | Fruit mixture         | 49,8225      | 87,0400   | 0,9473                  | 0,9456                 | 34,67                    | 41,5                     |
| 8  | Blăgești Bacau       | Marc                  | 49,8225      | 87,6560   | 0,9597                  | 0,9580                 | 27,44                    | 33,02                    |
| 9  | Blăgești Bacau       | Marc                  | 49,8225      | 88,0730   | 0,9680                  | 0,9663                 | 21,83                    | 26,6                     |
| 1  | Blăgești Bacau       | Marc                  | 49,8225      | 86,1615   | 0,9297                  | 0,9281                 | 43,48                    | 51,0                     |
| 11 | Buhuși Bacau         | Fruit mixture         | 49,8225      | 87,6848   | 0,9602                  | 0,9585                 | 27,12                    | 32,9                     |
| 12 | Filipești Bacau      | Plums                 | 49,8225      | 87,4555   | 0,9556                  | 0,9539                 | 29,96                    | 36,1                     |
| 13 | Racova Bacau         | Fruit mixture         | 49,8225      | 87,5523   | 0,9576                  | 0,9559                 | 26,75                    | 32,4                     |
| 14 | Racova Bacau         | Marc                  | 49,8225      | 88,1044   | 0,9687                  | 0,9670                 | 21,32                    | 26,0                     |
| 15 | Palanca Bacau        | Fruit mixture         | 49,8225      | 85,3169   | 0,9127                  | 0,9111                 | 51,29                    | 59,1                     |
| 16 | Ghimeș Bacau         | Fruit mixture         | 49,8225      | 86,3815   | 0,9341                  | 0,9325                 | 41,36                    | 48,8                     |
| 17 | Ghimeș Bacau         | Fruit mixture         | 49,8225      | 87,2625   | 0,9518                  | 0,9501                 | 32,21                    | 38,7                     |
| 18 | Palanca Bacau        | Plum                  | 49,8225      | 87,4320   | 0,9552                  | 0,9535                 | 30,20                    | 36,4                     |
| 19 | N.Bălcescu Bacau     | Marc                  | 49,8225      | 85,9344   | 0,9251                  | 0,9236                 | 45,59                    | 53,3                     |
| 20 | N.Bălcescu Bacau     | Marc                  | 49,8225      | 86,3125   | 0,9327                  | 0,9311                 | 42,02                    | 49,5                     |
| 21 | Fărăoani Bacau       | Marc                  | 49,8231      | 85,7265   | 0,9209                  | 0,9193                 | 47,58                    | 55,3                     |
| 22 | Valea Mică Bacau     | Fruit mixture         | 49,8231      | 84,0805   | 0,8879                  | 0,8864                 | 62,22                    | 69,8                     |
| 23 | Ghe Doja Bacau       | Marc                  | 49,8231      | 85,4940   | 0,9163                  | 0,9147                 | 49,67                    | 56,5                     |
| 24 | Oituz Bacau          | Marc/<br>Apples 2007  | 49,8231      | 85,1385   | 0,9091                  | 0,9075                 | 52,80                    | 60,7                     |
| 25 | Soncut Bacau         | Marc 2008             | 49,8231      | 87,1850   | 0,9502                  | 0,9485                 | 33,08                    | 39,7                     |
| 26 | Pâncești Bacau       | Apricots 2008         | 49,8231      | 86,8208   | 0,9429                  | 0,9412                 | 37,00                    | 44,1                     |
| 27 | Soncut Bacau         | Marc 2004             | 49,8231      | 87,0494   | 0,9475                  | 0,9458                 | 34,56                    | 41,3                     |
| 28 | Mărgineni Bacau      | Fruit mixture<br>2008 | 49,8231      | 86,9285   | 0,9450                  | 0,9433                 | 35,89                    | 42,8                     |
| 29 | Ghimeș Bacau         | Plum                  | 49,8231      | 87,2156   | 0,9508                  | 0,9491                 | 32,75                    | 39,3                     |
| 30 | Marasesti Vrancea    | Marc 2008             | 49,8231      | 86,9495   | 0,9455                  | 0,9438                 | 35,63                    | 42,5                     |
| 31 | Corbasca Bacau       | Marc 2008             | 49,8231      | 87,8378   | 0,9633                  | 0,9616                 | 25,18                    | 30,6                     |
| 32 | L. Veche Bacau       | Fruit mixture<br>2008 | 49,8231      | 87,6020   | 0,9586                  | 0,9569                 | 28,13                    | 34,0                     |
| 33 | Lipova Bacau         | Marc 2008             | 49,8231      | 87,2830   | 0,9522                  | 0,9505                 | 31,95                    | 38,4                     |
| 34 | Lipova Bacau         | Marc 2007             | 49,8231      | 87,2850   | 0,9522                  | 0,9505                 | 31,95                    | 38,4                     |
| 35 | Petrești Bacau       | Plum 2007             | 49,8231      | 86,2368   | 0,9312                  | 0,9296                 | 42,70                    | 50,2                     |
| 36 | Petrești Bacau       | Fruit 2008            | 49,8231      | 86,4910   | 0,9363                  | 0,9347                 | 40,28                    | 47,6                     |
| 37 | Petrești Bacau       | Marc 2007             | 49,8231      | 85,4535   | 0,9154                  | 0,9138                 | 50,80                    | 58,6                     |
| 38 | Petrești Bacau       | Marc 2007             | 49,8231      | 85,7035   | 0,9205                  | 0,9189                 | 47,75                    | 55,5                     |
| 39 | Pârjol Bacau         | Marc 2007             | 49,8231      | 87,3849   | 0,9542                  | 0,9525                 | 30,80                    | 37,1                     |
| 40 | Pârjol Bacau         | Marc 2007             | 49,8231      | 87,3990   | 0,9545                  | 0,9528                 | 30,62                    | 37,9                     |
| 41 | Bogdana Bacau        | Plum 2007             | 49,8231      | 87,6930   | 0,9604                  | 0,9587                 | 27,00                    | 32,8                     |
| 42 | Șt. C. Mare Bacau    | Apple<br>brandy 2008  | 49,8231      | 85,7900   | 0,9222                  | 0,9207                 | 46,24                    | 53,9                     |
| 43 | Șt. C. Mare Bacau    | Fruit 2008            | 49,8110      | 86,8495   | 0,9437                  | 0,9420                 | 36,58                    | 43,6                     |
| 44 | Șt. C. Mare Bacau    | Marc 2007             | 49,8110      | 87,4450   | 0,9558                  | 0,9541                 | 29,84                    | 36                       |
| 45 | Bogdana Bacau        | Apples 2008           | 49,8110      | 87,9410   | 0,9656                  | 0,9639                 | 23,52                    | 28,6                     |
| 46 | Oituz Bacau          | Plum 2008             | 49,8110      | 87,9226   | 0,9652                  | 0,9635                 | 23,80                    | 29,0                     |
| 47 | Oituz Bacau          | Marc 2008             | 49,8110      | 87,0417   | 0,9475                  | 0,9458                 | 34,56                    | 41,2                     |
| 48 | M. Casin Bacau       | Fruit 2007            | 49,8110      | 88,1534   | 0,9699                  | 0,9682                 | 20,45                    | 25,0                     |
| 49 | M. Casin Bacau       | Plum                  | 49,8110      | 87,4915   | 0,9566                  | 0,9549                 | 29,36                    | 35,4                     |
| 50 | Cireșești Bacau      | Plum                  | 49,8110      | 87,5680   | 0,9581                  | 0,9564                 | 27,18                    | 32,9                     |
| 51 | Urechești Bacau      | Fruit 2007            | 49,8110      | 86,9192   | 0,9451                  | 0,9434                 | 35,84                    | 42,8                     |
| 52 | Câmpina Brasov       | Plum 2007             | 49,8110      | 87,3683   | 0,9541                  | 0,9524                 | 30,86                    | 37,1                     |
| 53 | Sascut Bacau         | Marc 2007             | 49,8110      | 86,3662   | 0,9340                  | 0,9324                 | 41,41                    | 48,9                     |
| 54 | Bihor                | Plum brandy           | 49,8110      | 86,4530   | 0,9357                  | 0,9341                 | 40,57                    | 47,9                     |
| 55 | Panciu Vrancea       | Marc 2008             | 49,8110      | 87,0920   | 0,9486                  | 0,9469                 | 33,97                    | 40,7                     |
| 56 | Panciu Vrancea       | Fruit 2007            | 49,8110      | 87,5945   | 0,9586                  | 0,9569                 | 29,13                    | 35,2                     |
| 57 | Straoani Bacau       | Fruit 2007            | 49,8110      | 87,3583   | 0,9539                  | 0,9522                 | 30,97                    | 37,3                     |
| 58 | Straoani Bacau       | Fruit 2007            | 49,8110      | 87,2840   | 0,9524                  | 0,9507                 | 31,84                    | 38,3                     |
| 59 | Straoani Bacau       | Marc 2008             | 49,8110      | 87,3592   | 0,9539                  | 0,9522                 | 30,97                    | 37,3                     |

| No | Source of the sample | Characteristics        | Annual water | The mass of the pycnometer with the product in g. | Relative density P20/20 | Relative density P20/4 | C% in weight percentages | %C in volume percentages |
|----|----------------------|------------------------|--------------|---|-------------------------|------------------------|--------------------------|--------------------------|
| 60 | Movilita Galati      | Plants 2007            | 49,8110      | 87,8975   | 0,9647                  | 0,9630                 | 24,14                    | 29,4                     |
| 61 | Bacau                | Marc 2008              | 49,8110      | 86,1610   | 0,9299                  | 0,9283                 | 43,38                    | 50,9                     |
| 62 | Bacau                | Marc 2008              | 49,8110      | 86,6895   | 0,9405                  | 0,9389                 | 38,18                    | 45,3                     |
| 63 | Tamasi Bacau         | Marc 2008              | 49,8184      | 86,4255   | 0,9350                  | 0,9334                 | 40,92                    | 48,3                     |
| 64 | Petresti Bacau       | Marc 2007              | 49,8184      | 86,3122   | 0,9328                  | 0,9312                 | 41,99                    | 49,4                     |
| 65 | Petresti Bacau       | Marc 2007              | 49,8184      | 85,3570   | 0,9136                  | 0,9120                 | 50,89                    | 58,7                     |
| 66 | Hateg Suceava        | Plum 2008              | 49,8184      | 86,9898   | 0,9464                  | 0,9447                 | 35,15                    | 42,0                     |
| 67 | Buciumeni, Galati    | Marc 2008              | 49,8184      | 86,4620   | 0,9358                  | 0,9342                 | 40,53                    | 47,9                     |
| 68 | Hateg Suceava        | Fruit 2007             | 49,8184      | 87,8285   | 0,9632                  | 0,9615                 | 25,16                    | 30,6                     |
| 69 | R. Sarat Buzau       | Marc 2002              | 49,8184      | 86,8584   | 0,9437                  | 0,9420                 | 36,58                    | 43,6                     |
| 70 | R. Sarat Buzau       | Marc 2003              | 49,8184      | 87,3163   | 0,9529                  | 0,9512                 | 31,55                    | 37,9                     |
| 71 | R. Sarat Buzau       | Marc 2000              | 49,8184      | 86,5574   | 0,9377                  | 0,9361                 | 39,58                    | 46,9                     |
| 72 | R. Sarat Buzau       | Plum 2005              | 49,8184      | 85,8738   | 0,9240                  | 0,9224                 | 46,15                    | 53,9                     |
| 73 | Râmnicu Sarat BZ     | Marc 2008              | 49,8184      | 87,4005   | 0,9546                  | 0,9529                 | 30,53                    | 37,9                     |
| 74 | Comanesti BC         | Plum 2008              | 49,8184      | 87,9353   | 0,9653                  | 0,9636                 | 23,73                    | 28,9                     |
| 75 | Comanesti BC         | Plum 2008              | 49,8184      | 87,8524   | 0,9637                  | 0,9620                 | 24,82                    | 30,2                     |
| 76 | Comanesti BC         | Marc 2008              | 49,8184      | 87,8520   | 0,9637                  | 0,9620                 | 24,82                    | 30,2                     |
| 77 | Comanesti BC         | Marc 2008              | 49,8184      | 87,9015   | 0,9647                  | 0,9630                 | 24,14                    | 29,4                     |
| 78 | Comanesti BC         | Plum 2008              | 49,8184      | 87,9070   | 0,9648                  | 0,9631                 | 24,07                    | 29,3                     |
| 79 | Comanesti BC         | Fruit mixture 2007     | 49,8184      | 87,9363   | 0,9654                  | 0,9637                 | 23,66                    | 28,8                     |
| 80 | Comanesti BC         | Marc 2007              | 49,8184      | 85,4215   | 0,9149                  | 0,9133                 | 50,30                    | 58,1                     |
| 81 | Comanesti BC         | Marc 2007              | 49,8212      | 87,9299   | 0,9652                  | 0,9535                 | 30,20                    | 36,4                     |
| 82 | Comanesti BC         | Marc 2007              | 49,8212      | 87,3103   | 0,9527                  | 0,9510                 | 31,67                    | 38,1                     |
| 83 | Comanesti BC         | Fruit mixture 2008     | 49,8212      | 86,3417   | 0,9333                  | 0,9317                 | 41,75                    | 49,2                     |
| 84 | Comanesti BC         | Fruit mixture 2008     | 49,8212      | 86,6154   | 0,9388                  | 0,9372                 | 39,03                    | 46,3                     |
| 85 | Comanesti BC         | Fruit mixture 2007     | 49,8212      | 87,2817   | 0,9522                  | 0,9505                 | 31,95                    | 38,4                     |
| 86 | Comanesti BC         | Fruit mixture 2008     | 49,8212      | 86,2320   | 0,9311                  | 0,9295                 | 42,81                    | 50,3                     |
| 87 | Comanesti BC         | Marc 2007              | 49,8212      | 88,9896   | 0,9864                  | 0,9846                 | 8,19                     | 10,9                     |
| 88 | Bacau                | Marc 2007              | 49,8212      | 86,8910   | 0,9443                  | 0,9426                 | 36,23                    | 43,2                     |
| 89 | Comanesti BC         | Fruit mixture 2007     | 49,8212      | 85,5610   | 0,9176                  | 0,9160                 | 49,08                    | 56,9                     |
| 90 | Hemeiusi BC          | Marc 2008              | 49,8212      | 86,5690   | 0,9379                  | 0,9363                 | 39,48                    | 46,8                     |
| 91 | Câmpina BV           | Plum 2007              | 49,8212      | 86,9160   | 0,9448                  | 0,9431                 | 36,00                    | 42,9                     |
| 92 | Bacau                | Apricots 2007          | 49,8212      | 87,0460   | 0,9474                  | 0,9457                 | 34,61                    | 41,4                     |
| 93 | Tarcau NT            | Plum 2007              | 49,8212      | 87,1541   | 0,9496                  | 0,9479                 | 33,41                    | 40,0                     |
| 94 | Asau BC              | Marc 2007              | 49,8212      | 86,6670   | 0,9398                  | 0,9382                 | 38,53                    | 45,7                     |
| 95 | V. Muntelui          | Fruit mixture 2008     | 49,8212      | 85,8702   | 0,9238                  | 0,9222                 | 46,24                    | 54,0                     |
| 96 | Bacau                | Balm/mint mixture 2007 | 49,8212      | 87,2138   | 0,9508                  | 0,9491                 | 32,75                    | 39,3                     |
| 97 | Bacau                | Schintel mixture 2007  | 49,8212      | 86,6200   | 0,9389                  | 0,9373                 | 38,98                    | 46,2                     |
| 98 | Bistrita N.          | Brandy fruit 2007      | 49,8212      | 86,5220   | 0,9369                  | 0,9353                 | 39,18                    | 46,4                     |

After analysing the 98 samples of brandy from different areas, we can observe that there are volume concentrations of ethanol from 10.9, the marc sample from Comanesti – Bacau, up to 69.8 the fruit mixture sample from Valea Mica – Bacau.

Table 2. Ethanol concentration in natural distillates from fruit mixture

| No. | Source of the natural distillates | Natural distillates | Ethanol concentration in weight percentages | Ethanol concentration in volume percentages |
|-----|-----------------------------------|---------------------|---|---|
| 7   | Blăgești BC                       | fruit mixture       | 34,67                                       | 41,5  |
| 11  | Buhuși BC                         | fruit mixture       | 27,12                                       | 32,9  |
| 13  | Racova BC                         | fruit mixture       | 26,75                                       | 32,4  |
| 15  | Palanca BC                        | fruit mixture       | 51,29                                       | 59,1  |
| 16  | Ghimeș BC                         | fruit mixture       | 41,36                                       | 48,8  |
| 17  | Ghimeș BC                         | fruit mixture       | 32,21                                       | 38,7  |
| 22  | Valea Mică BC                     | fruit mixture       | 62,22                                       | 69,8  |
| 48  | M. Casin BC                       | fruit mixture 2007  | 20,45                                       | 25,0  |
| 51  | Urechești BC                      | fruit mixture 2007  | 35,84                                       | 42,8  |
| 56  | Panciu VN                         | fruit mixture 2007  | 29,13                                       | 35,2  |
| 57  | Straoani BC                       | fruit mixture 2007  | 30,97                                       | 37,3  |
| 58  | Straoani BC                       | fruit mixture 2007  | 31,84                                       | 38,3  |
| 68  | Hateg SV                          | fruit mixture 2007  | 25,16                                       | 30,6  |
| 79  | Comanesti BC                      | fruit mixture 2007  | 23,66                                       | 28,8  |
| 85  | Comanesti BC                      | fruit mixture 2007  | 31,95                                       | 38,4  |
| 89  | Comanesti BC                      | fruit mixture 2007  | 49,08                                       | 56,9  |
| 28  | Mărgineni BC                      | fruit mixture 2008  | 35,89                                       | 42,8  |
| 32  | L. Veche BC                       | fruit mixture 2008  | 28,13                                       | 34,0  |
| 36  | Petrești BC                       | fruit mixture 2008  | 40,28                                       | 47,6  |
| 43  | Șt. Cel Mare BC                   | fruit mixture 2008  | 36,58                                       | 43,6  |
| 83  | Comanesti BC                      | fruit mixture 2008  | 41,75                                       | 49,2  |
| 84  | Comanesti BC                      | fruit mixture 2008  | 39,03                                       | 46,3  |
| 86  | Comanesti BC                      | fruit mixture 2008  | 42,81                                       | 50,3  |
| 95  | V. Muntelui                       | fruit mixture 2008  | 46,24                                       | 54,0  |

In these samples there are values from 25.0% for a sample from Casin Monastery – Bacau to 69.8% for sample from Valea Mica – Bacau (table 2).

Table 3. Ethanol concentration in different mixtures

| No | Source of the natural distillates | Natural distillates        | Ethanol concentration in weight percentages | Ethanol concentration in volume percentages |
|----|-----------------------------------|----------------------------|---|---|
| 96 | Bacau                             | Balm and mint mixture 2007 | 32,75                                       | 39,3  |
| 97 | Bacau                             | Schintel mixture 2007      | 38,98                                       | 46,2  |
| 92 | Bacau                             | apricot 2007               | 34,61                                       | 41,4  |
| 60 | Movilita GL                       | Plant Decoct 2007          | 24,14                                       | 29,4  |
| 45 | Bogdana BC                        | apples 2008                | 23,52                                       | 28,6  |
| 98 | Bistrita N.                       | Fruit brandy 2007          | 39,18                                       | 46,4  |
| 42 | Șt. Cel Mare BC                   | Apple brandy 2008          | 46,24                                       | 53,9  |
| 54 | Bihor                             | Plum brandy                | 40,57                                       | 47,9  |
| 26 | Pancesti BC                       | apricot 2008               | 37,00                                       | 44,1  |

There were values between 28.6% for an apple brandy in Bogdana – Bacau and 53.9% for an apple brandy in St. Cel Mare – Bacau (table 3).

Table 4. Ethanol concentration for plum distillates

| No. | Source of the natural distillates | Natural distillates | Ethanol concentration in weight percentages | Ethanol concentration in volume percentages |
|-----|-----------------------------------|---------------------|---|---|
| 12  | Filipești BC                      | Plum                | 29,96                                       | 36,1  |
| 18  | Palanca BC                        | Plum                | 30,20                                       | 36,4  |
| 29  | Ghimeș BC                         | Plum                | 32,75                                       | 39,3  |
| 49  | M. Casin BC                       | Plum                | 29,36                                       | 35,4  |
| 50  | Cireșești BC                      | Plum                | 27,18                                       | 32,9  |
| 72  | Râmnicu Sarat BZ                  | Plum 2005           | 46,15                                       | 53,9  |
| 35  | Petrești BC                       | Plum 2007           | 42,70                                       | 50,2  |
| 41  | Bogdana BC                        | Plum 2007           | 27,00                                       | 32,8  |
| 52  | Câmpina BV                        | Plum 2007           | 30,86                                       | 37,1  |
| 91  | Câmpina BV                        | Plum 2007           | 36,00                                       | 42,9  |
| 93  | Tarcau NT                         | Plum 2007           | 33,41                                       | 40,0  |
| 46  | Oituz BC                          | Plum 2008           | 23,80                                       | 29,0  |

| No. | Source of the natural distillates | Natural distillates | Ethanol concentration in weight percentages | Ethanol concentration in volume percentages |
|-----|-----------------------------------|---------------------|---|---|
| 66  | Hateg SV                          | Plum 2008           | 35,15                                       | 42,0  |
| 74  | Comanesti BC                      | Plum 2008           | 23,73                                       | 28,9  |
| 75  | Comanesti BC                      | Plum 2008           | 24,82                                       | 30,2  |
| 78  | Comanesti BC                      | Plum 2008           | 24,07                                       | 29,3  |

The ethanol concentration values in volume percentages are between 28.9% for a sample in Comanesti and 53.9% for a sample in Ramnicu Sarat – Buzau (table 4).

Table 5. Ethanol concentration in marc distillates

| No. | Source of the natural distillates | Natural distillates | Ethanol concentration in weight percentages | Ethanol concentration in volume percentages |
|-----|-----------------------------------|---------------------|---|---|
| 1   | Mărgineni BC                      | Marc                | 46,84                                       | 54,6  |
| 2   | Mărgineni BC                      | Marc                | 32,12                                       | 38,6  |
| 3   | Mărgineni BC                      | Marc                | 30,32                                       | 36,5  |
| 4   | Lipova BC                         | Marc                | 31,03                                       | 37,4  |
| 5   | Racova BC                         | Marc                | 39,53                                       | 46,8  |
| 6   | Racova BC                         | Marc                | 20,08                                       | 24,6  |
| 8   | Blăgești BC                       | Marc                | 27,44                                       | 33,02                                       |
| 9   | Blăgești BC                       | Marc                | 21,83                                       | 26,6  |
| 10  | Blăgești BC                       | Marc                | 43,48                                       | 51,0  |
| 14  | Racova BC                         | Marc                | 21,32                                       | 26,0  |
| 19  | N. Bălcescu BC                    | Marc                | 45,59                                       | 53,3  |
| 20  | N. Bălcescu BC                    | Marc                | 42,02                                       | 49,5  |
| 21  | Fărăoani BC                       | Marc                | 47,58                                       | 55,3  |
| 23  | Ghe Doja BC                       | Marc                | 49,67                                       | 56,5  |
| 71  | Râmnicu Sarat BZ                  | Marc 2000           | 39,58                                       | 46,9  |
| 69  | Râmnicu Sarat BZ                  | Marc 2002           | 36,58                                       | 43,6  |
| 70  | Râmnicu Sarat BZ                  | Marc 2003           | 31,55                                       | 37,9  |
| 27  | Soncut BC                         | Marc 2004           | 34,56                                       | 41,3  |
| 34  | Lipova BC                         | Marc 2007           | 31,95                                       | 38,4  |
| 37  | Petrești BC                       | Marc 2007           | 50,80                                       | 58,6  |
| 38  | Petrești BC                       | Marc 2007           | 47,75                                       | 55,5  |
| 39  | Pârjol BC                         | Marc 2007           | 30,80                                       | 37,1  |
| 40  | Pârjol BC                         | Marc 2007           | 30,62                                       | 37,9  |
| 44  | Șt. Cel Mare BC                   | Marc 2007           | 29,84                                       | 36  |
| 53  | Sascut BC                         | Marc 2007           | 41,41                                       | 48,9  |
| 64  | Petresti BC                       | Marc 2007           | 41,99                                       | 49,4  |
| 65  | Petresti BC                       | Marc 2007           | 50,89                                       | 58,7  |
| 80  | Comanesti BC                      | Marc 2007           | 50,30                                       | 58,1  |
| 81  | Comanesti BC                      | Marc 2007           | 30,20                                       | 36,4  |
| 82  | Comanesti BC                      | Marc 2007           | 31,67                                       | 38,1  |
| 87  | Comanesti BC                      | Marc 2007           | 8,19  | 10,9  |
| 88  | Bacau                             | Marc 2007           | 36,23                                       | 43,2  |
| 94  | Asau BC                           | Marc 2007           | 38,53                                       | 45,7  |
| 25  | Soncut BC                         | Marc 2008           | 33,08                                       | 39,7  |
| 30  | Marasesti VN                      | Marc 2008           | 35,63                                       | 42,5  |
| 31  | Corbasca BC                       | Marc 2008           | 25,18                                       | 30,6  |
| 33  | Lipova BC                         | Marc 2008           | 31,95                                       | 38,4  |
| 47  | Oituz BC                          | Marc 2008           | 34,56                                       | 41,2  |
| 55  | Panciu VN                         | Marc 2008           | 33,97                                       | 40,7  |
| 59  | Straoani BC                       | Marc 2008           | 30,97                                       | 37,3  |
| 61  | Bacau                             | Marc 2008           | 43,38                                       | 50,9  |
| 62  | Bacau                             | Marc 2008           | 38,18                                       | 45,3  |
| 63  | Tamasi BC                         | Marc 2008           | 40,92                                       | 48,3  |
| 67  | Buciumeni, GL                     | Marc 2008           | 40,53                                       | 47,9  |
| 73  | Râmnicu Sarat BZ                  | Marc 2008           | 30,53                                       | 37,9  |
| 76  | Comanesti BC                      | Marc 2008           | 24,82                                       | 30,2  |
| 77  | Comanesti BC                      | Marc 2008           | 24,14                                       | 29,4  |
| 90  | Hemeiusi BC                       | Marc 2008           | 39,48                                       | 46,8  |
| 24  | Oituz BC                          | Marc si mere 2007   | 52,80                                       | 60,7  |

The ethanol concentrations are from 10.9 for a sample in Comanesti – Bacau to 60.7% for a sample in Oituz – Bacau (table 5).

In relation to the number of collected sample, the highest weight is for the marc distillates, 49%, 25% out of the samples are fruit mixture, 17% plum and 9% different mixtures (diagram 1).

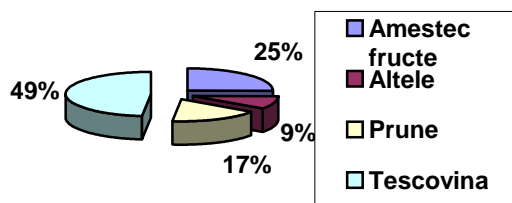


Diagram 1. The weight of the samples according to the type of natural distillate

## CONCLUSIONS

For the study of ethanol concentration of natural distillates were considered 98 samples of brandy that were taken from different places in Moldavia.

The distillates were processed after traditional recipes from mixtures, fruits and marc. From all the samples 49% were marc, 25% fruit mixture, 17% plums and 9% other mixtures.

The method that was used is approved by the Romanian and the EU legislation, which is Pycnometry. For weighing the samples a Pyrex pycnometer was used.

The weighing was done with an analytical balance with four decimal places.

Working parameters were established, namely the temperature of samples and the pycnometer for 30 minutes at +20°C, the mass of the empty pycnometer and the filled with water pycnometer were established, in order to determine the annual water.

In order to determine the relative density of the distillates, each sample was weighted in the pycnometer in constant temperature conditions. The relative density of the distillates at +20°C with water at +20°C was calculated according to the formula:

$$P20/20 = (G3 - G1) : G$$

Making the average concentration value in volume percentage of ethanol in the analyzes samples, it is noticeable that the samples with the highest alcoholic concentration are from fruit mixtures (diagram 2).

Average concentration in volume percentage of ethanol

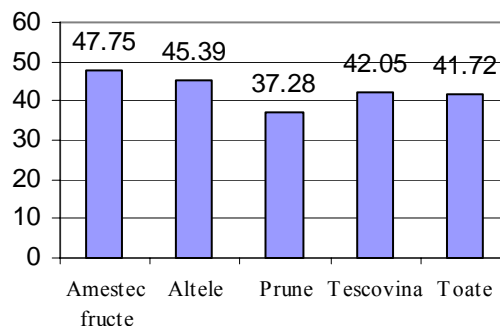


Diagram 2. The average variation of ethanol concentration (in volume percentage) according to the natural distillates

P20/20 – the relative density at +20°C related with water at +20°C;

G – the value of the annual water

G1 – the mass of the empty pycnometer

G3 – the mass of the pycnometer and the sample

Determining the real relative density, respectively the value of the relative density of the samples at +20°C with water at +4°C was calculated according to the density of water at +20°C with water at +4°C, as well as the air density at +20°C with water at +4°C.

$$P20/4 = (0,99823 - 0,00120) P20/20 + 0,00120 = 0,99703 \times P20/20 + 0,00120$$

P20/4 – relative density at +20°C and water at +4°C;

P20/20 – relative density at +20°C with water at +20°C;

0,99823 – water density at +20°C with water at +4°C;

0,00120 – air density with water at +4°C.

The obtained values for the real relative density P20/4 of the distillates are reported in tables approved by the World Organization of Legal Metrology from which the values of distilled alcohol concentration in weight percent are obtained.

Based on the alcoholic concentration in weight percentage the real concentration in volume percentage results (table 1) according to the tables that are found in the STAS sites and in the Romanian legislation as well as in the 22 th Recommendation of OMML.

After analysing the 98 samples of brandy from different areas, it is noted that ethanol concentration in volume percent are found from 10.9, the marc sample in Comanesti – Bacau, up to 69.8, the fruit mixture sample in Valea Mica – Bacau. (table 1)

As for the different fruit mixture samples there are values between 25% to a sample in Casin Monastery – Bacau and 69.8% in Valea Mica – Bacau (table 2).

In the different fruit or different mixture samples there were values from 28.6% for an apple brandy in Bogdana- Bacau and 53.9% for an apple brandy in St. Cel Mare – Bacau (table 3).

For the plum distillates the value of the alcoholic concentration in volume percentage are from 28.9% for a sample in Comanesti and 53.9 for a sample in Ramnicu Sarat – Buzau (table 4).

In the case of the marc distillates the values are from 10.9 for a sample in Comanesti – Bacau up to 60.7 for a sample in Oituz – Bacau (table 5). Making the average value in volume percentage concentration of ethanol from the analyzed samples, it is noticed that the samples with the highest alcoholic concentration are from distillates of fruit mixture, the samples having in general an average ethanol concentration of 41.72 (diagram 2).

Following these determinations of ethanol concentration in volume percentage from natural distillates of different fruit mixture, fruit and marc, it is noted that these preparations may have different alcoholic concentration starting from very small values (10.9%), a value that does not comply with the existing STAS sites regarding the alcoholic concentration in distillates.

It is obviously that this product may not correspond to any legally sensory, this being a distillate that may contain a high concentration of volatile congeners with high boiling points with a real toxic potential.

The highest concentration was determined for a double distillate sample of fruit mixture, 69.8%. Obviously, this concentration is exceptional taking into account that the general average of ethanol concentration is of 41.7%. This shows that even by using traditional methods, from natural raw materials good quality distillates can be obtained that correspond to the STAS sites regarding the alcoholic concentration.

## ABSTRACT

The natural distillates that were studied have been taken from Moldavia between 2007 and 2008. The 98 samples represent products that resulted after the distillation of the mixture of fruit maceration extract (apples, pears, plums, grapes), simple plum or grape maceration extracts (marc).

These distillates are found all around the area, the recipes that are used are personal and thus they have a traditional character. In order to determine the alcoholic concentration in volumes, the pycnometer method was used, a method that is accepted by the laws in force.

The relative density and the real relative density were calculated, and based on the results the values of ethanol concentrations in volumes were obtained. There were values from 10.9% to 69.8%. The values of ethanol concentration for each batch of distillates were calculated according to the material they were treated from. The general average value of the ethanol concentration in volume percentage is of 41.7.

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