

MOONLIGHT & ROSES

by

John Stone



*“The alcohol provides the kicks.
All the rest is merely Moonlight & Roses”*

Sage and philosopher Johannes S. AD 2002

Moonlight & Roses

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by

**Saguenay International
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Contact:

**John Stone
17, Hudson Club Rd
Rigaud, QC
Canada J0P 1P0**

Tel: (450) 451-0644

Fax: (450) 451-7699

e-mail: pegasus@gin-vodka.com

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Moonlight & Roses

INTRODUCTION

Champagne, brandy, tequila, beer, wine, sherry, party punch.....the list goes on and on. The variety seems infinite. The colour, the aroma, the subtle flavours form a kaleidoscope of sensory experiences. And yet they all have one thing in common. Something which binds them all together and forms the basis for after-dinner toasts, for elegant dinner parties, for wedding receptions and booze-ups in pubs. This common denominator goes by the name of "alcohol".

What is beer but 5% alcohol flavoured with hops and coloured brown? What is wine but 12% alcohol flavoured with fermented grapes and coloured red? What is gin but 40% alcohol flavoured with juniper berries and with no colour at all? All these pleasant drinks are nothing more than flavoured alcohol, with a few bubbles added if you want a fizzy drink, a little colour to admire as you hold your glass up to the light, a subtle bouquet as you breathe deeply of the spirituous vapours rising from the snifter. Just alcohol -----all the rest is merely moonlight and roses.

The incentive for writing this book came from the discovery of a gold mine in the back yard. Not a literal gold mine of course but its equivalent. The discovery of the elegant but rather simple procedures and equipment required for making pure alcohol at a small fraction of the commercial price, e.g. in the neighbourhood of US \$1/litre. And this is a very nice neighbourhood. These procedures, and the equipment required, have been described in detail in a couple of earlier books by the author (1,2). The starting point is sugar, plain old supermarket sugar. Fermented with baker's yeast it yields a type of beer, and when this beer is run through a highly efficient fractionating still pure ethyl alcohol distils over leaving all the impurities behind. It is colourless, odourless and tasteless --- the characteristics of pure alcohol. The kick, of course, remains. This is the alcohol which lies at the heart of all beer, all wine and all spirits and is the one and only essential element in every alcoholic drink.

So, with an unlimited supply of very cheap and very pure alcohol at our disposal, the question arose ---- what on earth to do with it? It's a problem, but it's one of those problems which most of us could live with --- like the problem of what to do with \$1 million if we won it in a lottery. To help you out, to relieve you of the responsibility of figuring out an interesting way to use a plentiful supply of alcohol, this book has been written. It concludes that the best thing to do with a plentiful supply of alcohol is to a) flavour it in various ways, and b) drink it!

The reason for flavouring is self-evident. Pure alcohol, or vodka as we call it when diluted to 40% strength, is somewhat boring. This statement will appear sacrilegious to millions of people in Eastern Europe and elsewhere around the world, but we stick to our guns --- even the famous Russian distillery Stolichnaya is now offering lemon vodka, raspberry vodka, pepper

vodka, et cetera to relieve the monotony. As the old saying goes ---Man does not live by vodka alone. Neither does Woman --- she likes to add some orange juice to it and call it a screwdriver.

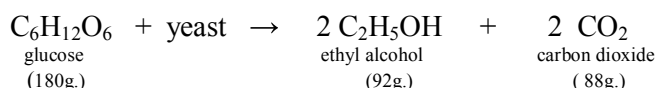
There are many, many ways to flavour vodka of course and later on we shall deal with each of them in turn, from the simplest method of them all --- adding vodka to a soft drink with some ice and a slice of lemon to make a highball --- to the more challenging and creative method of extracting one's own essential oils from plant material by steam distillation. And then there's the possibility of using commercial flavouring essences, essences which come in hundreds of different flavours. But before getting into the question of flavour let's first take a look at the alcohol itself --- what it is and how it is made.

ETHYL ALCOHOL

Before describing how to make pure alcohol you are invited to take a short course in alcohol chemistry. This will not only be good for your soul but also good for your alcohol because the more you know the better the results are likely to be. If a problem crops up ---- which is the inevitable result of Murphy's Law ---- you need to be able to correct it from a complete understanding of the system and not keep trying this and that until, by happenstance, the problem disappears (or doesn't, as the case may be).

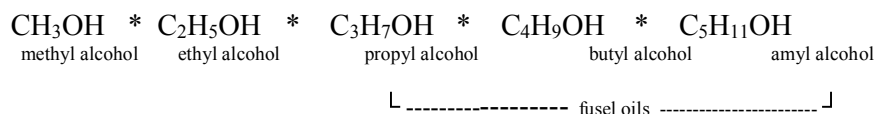
Ethyl alcohol is quite a simple chemical, and although it is best known for its contribution to party merriment it is also used in many scientific laboratories and in a wide variety of commercial applications, e.g. the perfume and cologne industries. In bulk quantities it is also used as an automotive fuel in Brazil and as an octane booster in gasohol in N. America.

The word "alcohol" is a generic term and refers to any chemical with an -OH group attached to the molecule. There are hundreds of them but few are potable, the best known of those which are being ethyl alcohol (often abbreviated to "ethanol") with the formula C₂H₅OH. It is derived from sugar by fermenting with yeast according to the formula below:



The atomic weights of carbon, hydrogen and oxygen are 12, 1 and 16 respectively, and when these weights are assigned to each of the atoms in the above equation we find that 180 grams of glucose will lead to the production of 92 grams of ethyl alcohol and 88 grams of carbon dioxide. As a rough approximation, therefore, a given weight of sugar will produce about half its weight of alcohol and half its weight of CO₂. This is a lot of carbon dioxide and the reason why yeast is used to make bread rise --- the CO₂ puffs up the dough. In commercial distilleries the CO₂ is sometimes collected and sold to carbonated beverage manufacturers to provide the fizz in soda pop.

Of the many alcohols commonly encountered in everyday life, other than ethanol, probably the best known is methanol or wood alcohol. It is called wood alcohol because, many years ago, when charcoal was being produced by heating wood chips in kilns in the absence of air, methanol distilled off. It has one carbon less than ethanol, has the formula CH₃OH, is poisonous, and nowadays is made from natural gas. Higher alcohols such as propanol (3 carbon atoms), butanol (4 carbon atoms) and amyl alcohol (5 carbon atoms) also are poisonous, and as a group are referred to as "fusel oils". Some people prefer the term "fusel alcohols", but there are other things present besides alcohols. However, as a group they are oily, so fusel oils isn't too bad a designation and is used widely in the alcohol business.



When yeast is added to a sugar solution in the presence of air it uses the sugar to grow (yeast is a type of plant). In the absence of air it sets to work and uses the sugar to produce ethyl alcohol, but small quantities of the other alcohols are made at the same time, plus a variety of other chemicals such as acids, esters, aldehydes and ketones. These all have a taste, the esters being a bit “fruity” while the others are rather unpleasant. Some are downright poisonous---- for example, the infamous methanol which in large quantities will blind you. Among the fusel alcohols, amyl alcohol is particularly noxious. In beer, wine and most spirits the same chemicals occur in small amounts, but the amounts present are insufficient to do you any serious harm. However, it is they and not the ethanol which are responsible for the headaches and hangovers which result from overindulgence (see Appendix V) so it’s good to get rid of them.

All these organic chemicals have different boiling points and, as a result, can be separated from one another and from water by distillation. This is the basis of distillation --- it separates chemicals according to their boiling points. Some of these chemicals are shown in Table I below.

Table 1. Boiling points

<u>Compound</u>	<u>Boiling point, °C.</u>
Acetone	56.5
Methanol	64.7
Ethyl acetate	77.1
Ethyl alcohol (96%), the azeotrope	78.1
Ethyl alcohol (100%)	78.4
Propyl alcohol	97.2
Water	100.0
Butyl alcohol	117.5
Amyl alcohol	137.8
Furfural	161.0

Physical properties

Density. Ethyl alcohol is a colourless liquid with a density of about 0.8 compared to 1.0 for water. It is important to appreciate this fact because a number of calculations are affected by it. For example, when you buy a bottle of whiskey or rum from a liquor store the strength will be given on the bottle as, say, 40%. This is on a volumetric basis (shown as v/v), i.e. there are 40 ml of alcohol in 100 ml of spirits. On a weight basis this means that there are $40 \times 0.8 = 32$ grams of alcohol in 100 grams of spirits.

Another example is provided by the yield of alcohol from a given weight of sugar. In the chemical equation given a couple of pages back it was shown that 180 grams of sugar should lead to 92 grams of ethanol upon fermentation (theoretical yield), but when you take the density into account these 92 grams represent 115 ml of 100% ethanol on a volumetric basis or 287 ml of 40% spirits. When simple arithmetic is being taught in elementary school this would be an excellent example to use.

Boiling point, melting point. Pure 100% ethyl alcohol boils at 78.4°C. at the standard atmospheric pressure of 760 mm of mercury. The azeotrope (see below) of 96% ethanol, 4% water (v/v) boils at 78.1°C. This is shown in Table I above. These boiling points are markedly affected by the atmospheric pressure, which changes from day to day as air masses move across a region, and also by the elevation above or below sea level. The effect is by no means trivial. This relationship is given in Appendix I at the end of the book and you may wish to refer to it when carrying out a distillation.

The melting point of ethanol (or freezing point if you prefer), is -114.9°C. so it would make a good antifreeze. Its octane rating is about 112, or 16 points higher than premium gasoline, and because there is an oxygen atom in the molecule it provides a little oxygen right inside the gasoline, in addition to the oxygen brought in from the outside air by carburetion. This means that when 10% ethanol is added to gasoline, as in gasohol, a clean burning high-octane fuel is the result.

Taste & smell. Pure alcohol has virtually no taste --- merely an astringent, biting quality. There are some who claim it has a slightly sweet taste but the author cannot detect even a trace of sweetness. One thing is certain --- the slightest impurity, as measured in parts per billion, will be detectable by a sensitive palate. Manufacturers of vodka, with all the modern analytical instrumentation such as gas chromatographs available to them, will still employ panels of 10 individuals for "organoleptic" testing (taste & smell) --- the ultimate criteria of purity. The score sheet each panel member is given to mark has the following qualities listed:

Score	Meaning
10	Excellent – No discernable odour
9	Very good- Only very slight odour
8	Good – No unpleasant odour
7	Slightly good – Slight unpleasant odour
6	Borderline – Noticeable unpleasant odour
5	Unacceptable –Too much off-odour
4	Bad
3	Very bad
2	Terrible – Unpleasant
1	Sickening

When you start to make your own alcohol according to the directions in this book and in reference (1) let's hope you achieve a score of 7 to 8 the first time around and 10 before too long.

Manufacturers of colognes and perfumes use ethyl alcohol as a diluent and understandably cannot tolerate even a trace of odour coming from the alcohol. Their exacting standards are a challenge to distillers of industrial alcohol, but the specifications are met routinely and are proof that all impurities can be removed and that pure alcohol really doesn't have an odour of its own.

Metabolism. More than 90% of the alcohol that enters the body is completely oxidized to acetic acid (vinegar). This process occurs primarily in the liver. The remainder of the alcohol is not metabolized and is excreted either in the sweat, urine, or given off in one's breath. The latter provides the basis of the breathalyzer test used in law enforcement and is the reason one can smell alcohol on the breath of someone who has been drinking recently.

Heavy drinkers ingest more alcohol than the liver enzymes can handle, resulting in fatty liver and cirrhosis (scarring) of the liver after prolonged abuse.

The azeotrope.

An azeotrope is a mixture of two liquids with a boiling point lower than either constituent. In the case of ethanol and water the azeotrope occurs at a mixture of about 96% ethanol (v/v) and 4% water. The boiling point of this azeotrope is 78.1°C. whereas the boiling point of 100% ethanol is 78.4°C. During distillation the system registers the azeotrope as a separate substance with a boiling point of 78.1°C. and proceeds to separate it on this basis. The ethanol which is purified by a fractionating column is not, therefore, pure 100% ethanol but pure 96%, the "impurity" being 4% of pure water. No amount of re-distillation under the conditions we are using will influence this percentage.

If it is absolutely essential to remove all the water, for example if it is to be mixed with gasoline to produce gasohol, then benzene can be added to break the azeotrope, followed by re-distillation. For our purposes, however, where we are going to dilute the alcohol with water to 40% or less, the presence of 4% water is of no consequence.

A knowledge of the existence of this azeotrope is important because whenever we talk about "pure" alcohol it must be understood that we are usually talking about 96% alcohol, not 100%. Without knowing about the azeotrope it would be easy to believe that the 96% alcohol produced by fractional distillation contained 4% of impurities. It doesn't. It contains 4% of pure water.

Effect on behaviour

As we all know, alcohol also affects the central nervous system, with the results shown in Table II

Table II
Social effects of alcohol

<u>Concentration</u> (gms of alcohol per 100 ml of blood)	<u>Effects</u>
0.050	Congenial euphoria
0.075	Gregarious, garrulous
0.100	Legally intoxicated in most states
0.125 – 0.150	Unrestrained behaviour
0.200 – 0.250	Loss of alertness, lethargy
0.300 – 0.350	Stupor to coma
>0.400	Can be fatal, cardiac arrest

So there you have it. Congenial euphoria sounds pretty good to us. Of course, the rate at which alcohol accumulates in the blood following the consumption of a given volume of alcohol is markedly affected by body weight, by the amount of carbohydrates recently consumed, by gender, and by genetic variability, so slender ladies on a diet should watch it! We wouldn't want them to indulge in "unrestrained behaviour" now would we!

Alcohol and the law

As mentioned in the Introduction, the most important constituent of every alcoholic drink is the alcohol, and because of the taxation policies of most governments it is an expensive constituent. By making it oneself, however, it is possible to beat the tax and many people do this by making their own beer and wine. They are not making pure alcohol of course, they are making dilute, flavoured alcohol. And they're not saving a great deal of money.

We bring up the subject of alcohol and the law at a fairly early stage in this book because everyone is quite concerned about it. Rightfully so, because distilled spirits have had a bad press over the years and there's a great deal of misunderstanding floating around. The aim of this chapter is to reassure you that there is no moral dimension to distilling alcohol --- it is a perfectly innocent, harmless hobby which for historical reasons coupled with a bureaucratic mind-set is perceived by governments as being sinful, dangerous and downright nasty. On a par with child-molesting and mugging old ladies.

For completely illogical reasons all governments, with one or two notable exceptions, prohibit an amateur from purifying and concentrating his own homemade beer and wine by means of distillation. No reason can be found for this other than simple ignorance on the part of politicians and civil servants because distillation doesn't make alcohol, not a drop, it merely purifies it. We discuss this problem in a companion volume (1) so will not go into it in detail here. Furthermore, it is bad for the blood pressure!

New Zealand. It is pleasant to be able to report that one country with the intelligence and honesty to admit that amateur distillation is an acceptable hobby is New Zealand, which lifted the ban in 1996. Significantly, they were also the first country to give women the vote (1893), many years before any other country. (see also Item 7 below).

United States. Commendably, the United States currently has a Bill before Congress to do exactly the same thing (remove the ban on hobby distilling) so it seems that the message is slowly sinking in. This means that we who live in N. America south of the 49th parallel can look forward to the decriminalization of this heinous crime ---- purifying beer by boiling it and condensing the vapour. If and when this Bill is passed there is a reasonable chance that other countries around the world will wake up to the fact that they don't have a leg to stand on and, red-faced, will sheepishly admit that possibly, just possibly, they have been wrong all these years.

It is tempting to look for a reason why governments adopt such an illogical attitude towards distilling, and among the most obvious reasons are that governments believe that:

1. Distillation makes alcohol
2. The alcohol made by distillation is somehow different from that in beer and wine
3. Distillation makes the alcohol stronger and therefore more intoxicating
4. The stronger the alcohol the more likely it will lead to anti-social behaviour
5. Distilled spirits are less healthy than beer and wine
6. Amateur distillation is dangerous and could lead to blindness

7. Permitting amateurs to distil spirits would lead to a loss of jobs and tax revenue

Let's take a brief look at each of these possibilities.

1. Distillation doesn't make alcohol. It never has, never will, and is incapable of doing so. Alcohol is made by the fermentation of sugar, as in beer- and wine-making, and both these are legal activities for amateurs. Distillation is simply the purification of a legal product.
2. The alcohol in all beer, wines and spirits is identical --- C_2H_5OH
3. Distillation concentrates the alcohol by removing water, but it doesn't change the amount of alcohol.
4. It is the amount of alcohol and not its concentration which influences behaviour. The most anti-social behaviour is observed in beer drinkers, and beer is the least concentrated of all alcoholic beverages. For bureaucrats to believe something which is the exact opposite of the truth, and to enforce laws which run completely counter to experience in the real world, is a sad but fairly frequent occurrence. More in the same vein can be found in Appendix VI.
5. The first step in the distillation of beer to make spirits is to separate and discard the toxic "heads", so distillation leads to less congeners in the final beverage, not more. See Appendix V.
6. There has never been a recorded case of this. It is a bogeyman put about by vested interests. See also Appendix V.
7. Knowing governments, a loss of tax revenue is likely to be the most powerful reason for prohibiting amateur distillation. Even the thought of it brings officials out in a rash. However, New Zealand experience has shown that, as soon as amateurs were allowed to distil, there was a surge in interest in spirits because it had now become a hobby instead of a remote commercial enterprise. Consequently, commercial sales increased markedly and there was a corresponding increase in tax revenue.

If anyone wishes to change the law with respect to amateur distillation it would be a waste of time talking or writing to civil servants or politicians because their minds are made up. They are impervious to reason and logic. So the approach would have to be through the news media. Ridicule can be a powerful weapon.

Alcohol as a beverage

It seems to us from a lifetime of going to parties and of giving them that the main reason people drink alcoholic beverages is not because they like the taste particularly, but because they are alcoholic. The taste is important, of course, but not *all*-important. People will head for the bar and if they can't find a jugful of martini they'll settle for a gin & tonic instead. Or a bowl of punch if it happens to be sitting there. They'll seldom substitute a glass of water or a soft drink.

So it appears to us that, in the final analysis, when you arrive home from the office or arrive at a party not knowing too many of your fellow guests, it is the alcohol you're looking for. It is the alcohol which is more important than the flavour, aroma and colour. It is the kick which is more important than the moonlight.

A way to illustrate this is to use a rather far-fetched example. If Scotch whisky were to be processed through a high-efficiency fractionating still the alcohol could be removed and collected. It would leave a brown, watery liquid with a biting taste characteristic of tannins, esters, aldehydes, ketones, etc., etc. No-one would dream of drinking it. It would be vile. The alcohol which had been distilled off, however, would be vodka, and as we all know this is consumed with pleasure by many people.

Or take a litre of wine with a 12% alcohol content and distil it. Lo and behold, we'll get 300 ml of vodka and a residue containing the essence of what was once a beautiful Bordeaux or a full-bodied Burgundy. This residue would look like hell and taste like poison, but just remember where it came from!

Now consider the possibility of reversing this process, because this is what this book is all about. Starting with vodka we could add this ingredient and that and wind up with a bottle of rum, could we not? Or a sherry. Or a chateau-bottled wine of superlative quality. It would have the correct alcohol content of course because that's what we started out with (40% for the rum, 16% for the sherry and 12% for the wine), but whether or not it had the right taste would depend upon what we had added. When the flavour you're looking for happens to be a very complex mixture of dozens of trace ingredients, which is the case with commercial spirits, it's not all that easy to reproduce it.

But must we try to emulate commercial drinks exactly? Why, other than because we have become used to them. As a matter of fact, whenever we mix a cocktail it's because we have decided to generate our own flavour. There's nothing sacred about the flavours which come in bottles.

Understanding an alcoholic drink

What's to understand? Most people sip a drink, think of it as pleasant or otherwise, and then move on to something else. Who cares what its constituents are? Who cares how it was made? Quite right. Leave it to the analytical chemists, distillers and vintners to peer into the depths of a good martini or single malt scotch and make their pontifical judgements. However, if you intend to make your own alcoholic drinks you can't take anything for granted and need to know *something* about what makes an alcoholic drink tick. What is important and what is not. So here goes.

Advertising hype



An alcoholic drink can be considered as being made up of just three constituents --- alcohol, water and flavour. That's all that beer is, all that wine is, all that single malt Scotch is ---- just alcohol, water and flavour. But, there's a fourth ingredient found in all commercial alcoholic beverages which is often overlooked. This ingredient is known as "bullshit". You see, as soon as you have a product involving taste, or subjective judgements, you provide a fertile field for the spin doctors to start their brain-washing activities. They are paid large salaries to persuade you that their product is so beautifully crafted from such unique raw materials that it warrants digging deep into your pocket to purchase a bottle. Or to switch brands. Their grapes were grown in a uniquely rich soil on the southern slope of an enchanted hillside. The whisky was made from a special strain of barley, malted according to a secret formula handed down from father to son over ten generations, while the water used had flowed over granite rocks a million years old and filtered through peat to add that unique smoky flavour so beloved by true connoisseurs. A single malt whisky is given unpronounceable Gaelic names to persuade you that you have something very special in your glass, and in addition provides you with material for a little one-upmanship when you're chatting to your friends about the merits of this or that Scotch. The advertising hype even extends to bottled water, enabling shiploads of the stuff to be sent from Europe to N. America. Is there no limit to our gullibility! Remember --- "EVIAN" spelled backwards reads "NAÏVE".

In the real world where we all live, we have become accustomed to the combination of all four ingredients ---water, alcohol, flavour and bullshit ----and go to the liquor store to choose from an immense variety of commercial beers, wines and spirits, all of them laced with that special ingredient which puts fire in your belly and wicked thoughts in your head. From years of experience we know what we like, or what we've been told to like, or read in a magazine article what someone else likes, and make a purchase accordingly. But if we're going to make our own booze we have to rid ourselves of this fourth ingredient, to clear our minds of the propaganda which has been used to colour our judgement from cradle to grave. It's not easy, but advertising hype has no place in a beverage you make yourself so try to forget it, and substitute commonsense and sweet reason.

Drinking Alcohol



If you tried to drink pure, 100% ethanol it would take your breath away and you'd have to spit it out and drink a glass of water. It would burn your throat. When diluted to 40% with distilled water to give vodka it is still pretty strong, but can be sipped slowly and appreciatively. Most people dilute spirits even further with water, soda water, tonic or fruit juice, leaving the kick unchanged but providing a more thirst-quenching drink.

When we talk about beverage alcohol we are talking about ethyl alcohol. Potable alcohol. It is a simple, pure compound with the chemical formula C_2H_5OH . It has no colour, no odour, and no real taste other than a kind of astringent tickling of the palate. The colour, odour and taste come from the other constituents, the congeners, originally in the plant and reacted upon and modified by the fermentation. Ethyl alcohol is made from sugar by fermentation with yeast, and the alcohol component of all drinks is always the same regardless of whether you start with pure cane sugar from the supermarket, with the sugar in the juice squeezed from grapes, with starch from potatoes or corn, or even with lactose--- the sugar found in milk. The alcohol in beer and the alcohol in rye whiskey or champagne are the same alcohol --- just flavoured differently.

Ethyl alcohol is not poisonous. It is a very pure substance derived from natural plant sugars and will do you no harm whatsoever if drunk in moderation. In fact doctors often prescribe a little alcohol for elderly patients because it is so benign, and has a calming, soothing effect when imbibed in small quantities. It also reduces high blood pressure. In large quantities, as we all know, it can lead to exhilaration and the possibility of telling risqué jokes!

Congeners.

All commercial spirits with the exception of vodka and gin contain small quantities of substances known as congeners derived from the original feedstock (e.g. grapes, barley, corn, sugarcane) and modified and added to during the fermentation process. Some of these are coloured, some are pleasantly flavoured, some are unpleasantly flavoured, and some are toxic. The toxic congeners are such things as methanol, furfural, amyl alcohol, aldehydes and ketones. They are in beer, they are in wine, and they are in all spirits except vodka and gin. They, and they alone, are responsible for the headaches and hangovers you experience from time-to-time. It's not the alcohol. All that spirits manufacturers can do to alleviate this situation (it's not in their best interests that you go blind) is to conduct their distillation in such a way that at least some of the undesirable congeners are removed while some of the nicer ones are retained, and when this is done we are left with spirits which go by the name of whisky, brandy, rum, etc. depending on the original source of fermentable sugar. They provide flavour, but they can't avoid including a small amount of toxic substances at the same time. However, when we make our own flavoured drinks we don't want any noxious substances present if we can help it, and we can help it. Unlike the commercial producers we can achieve this very simply by using vodka as the base.

Making your own alcohol

Before you can start adding flavouring to vodka you first have to make it. Of course you don't have to make it, you could go out and buy it. Commercial vodka is not all that cheap, however, so you wouldn't save a great deal of money by buying vodka and then flavouring it. Flavouring only makes sense if you have a ready supply of vodka at very low cost, and with taxation the way it is and with manufacturers' mark-ups the way they are about the only way to achieve this is to make your own! People make their own beer and wine so why not make their own vodka? Fortunately, vodka is very much easier and cheaper to make than its two weaker cousins.

Don't be put off by thinking that low-cost means low quality; it doesn't. The quality will be impeccable, and the low cost is due solely to the fact that a litre of vodka can be made from a kilogram of sugar, and a kilogram of sugar costs just over \$1 in Canada. The yeast and the electricity used will cost just a few cents more. So the raw materials for a litre of vodka cost just over a dollar. (Ethyl alcohol is actually dirt cheap, as shown by the fact that it is used in gasohol.) Your labour (and not a great deal is involved) we assume will be donated free of charge because it's a hobby.

Feedstocks

Just about any 6-carbon sugar can be metabolized by brewer's (or baker's) yeast, gobbling it up and converting it to ethyl alcohol and carbon dioxide. However, if one's intention is to make a beer or wine to drink then the choice of sugar source becomes important because the other plant constituents which exist along with the sugar in the grape juice (or whatever) will add their own 2-cents worth to the final flavour. The choice of yeast also is important because different strains of *saccharomyces cerevisiae* lead to slightly different congener production. In our case, since we are going to produce pure alcohol with no trace flavours at all, the source of sugar and the strain of yeast are completely unimportant. Simply choose the cheapest sugar available to you where you live and the cheapest and most active yeast.

The most convenient, and probably the cheapest, source of fermentable sugar for most people will be found in the supermarket. Sucrose derived from sugarcane or sugarbeet is remarkably cheap and you'd be hard put to find a less expensive, purer and more convenient supply.



The other major source of 6-carbon sugars is the starch found in such things as potatoes and grain. Starch is a polymer of glucose and cannot be metabolized directly by yeast--- it first needs to be hydrolysed with enzymes or acid to break down the polymer chains to the glucose monomer. The method for doing this is outside the scope of this book but can be found in reference (4).

Alcohol can also be made by fermenting lactose, the 6-carbon sugar found in milk (milk contains about 5% lactose), but because a special yeast is needed and because cheese whey is unlikely to be available to the average hobbyist at a reasonable price no more will be said about it here.

Fermentation.

For a complete description of alcohol production ----equipment, fermentation and distillation ---- please refer to our earlier book entitled "Making Gin & Vodka --- *A Professional Guide for Amateur Distillers*" (1). For your convenience an abbreviated description will be given here.

Any large vessel can be used as a fermenter, and if you make beer or wine you probably already have the necessary equipment and know-how. However, if you're starting from scratch we recommend the use of a laundry tub as a fermenter. It's cheap (about \$25) a nice size (about 50 to 60 litres), stands on legs at a convenient height, and has a drain. It should be equipped with a plate-glass cover, a small immersion heater such as used in an aquarium to maintain the temperature at the optimum 33° C. for the approx. 5 days of fermentation, a circulating pump to keep the yeast cells in suspension (the submersible type such as used in an aquarium is ideal), and a ball valve on the drain. 10 kg of sugar are poured into the tub and cold water run in until the water level rises above the inlet to the circulating pump. The circulating pump and immersion heater are switched on and then 150 g. of active dry baker's yeast are sprinkled on the surface of the water. The temperature is allowed to rise to 33°C., dissolving the sugar, and maintained at that temperature for 5 to 6 days. The specific gravity, as measured by a hydrometer floating in the sugar solution, will drop from about 1.06 to 0.99 as the sugar is converted to alcohol.

The fermentation of ordinary sugar with baker's yeast gives a number of beginners trouble, e.g. low yields of alcohol or a slow fermentation, but with experience the problem seems to disappear. The key to success is to buy 450 gram (1 lb) packets of very fresh yeast which have been vacuum packed and sealed in metal foil. The use-by date must be well ahead --- as much as a couple of years. Also, buy it from a store which has a rapid turnover, the baking section of your supermarket being excellent in this regard. If you still have trouble try adding about 10 grams of a yeast nutrient such as Fermaid K. Yeast nutrient is normally used to promote the growth of small quantities of an expensive yeast at the start of a beer or wine fermentation, and theoretically should be unnecessary when we have used massive quantities of cheap baker's yeast, but in practice it sometimes helps, probably by replacing some of the yeast cells which have died.

When cane sugar is metabolized by yeast to "beer" the main product is ethyl alcohol but a host of minor compounds (congeners) are produced simultaneously, some of which have been shown in Table I above. This so-called "beer" will contain 5 to 10% alcohol, depending on the original concentration of the sugar solution. Don't be seduced into using special yeasts in order to produce a stronger alcoholic solution by using less water because it won't affect the amount of alcohol produced. The amount of alcohol is controlled by the amount of sugar you have used, not by the yeast and not by the water. There is no yeast nor yeast supplement which can produce more alcohol than the sugar allows. So start with a ca. 20% sugar solution and wind up with an 8 to 10% alcohol solution. You will be taking it up to 96% in your fractionating still later on so

whether you start with 5,10 or 15% “beer” affects nothing more than a tiny difference in the amount of electricity used.

Concentration & amount Many people will be irritated by the suggestion that they have difficulty distinguishing between concentration and amount, but the sad fact is that the majority of people we encounter --- and this includes scientists, philosophers, politicians and civil servants, not to mention the author’s wife --- not only have trouble with it but are reluctant to accept an explanation. So we seek your indulgence. If someone drinks can-after-can-after-can of 5% beer the final amount of alcohol consumed before he falls down will be considerable, and the fact that he had been drinking alcohol at only 5% concentration is irrelevant. So anyone who says that drinking 40% vodka is more likely to lead to inebriation than drinking 5% beer should go back to elementary school and brush up on his simple arithmetic. It is the amount of alcohol one consumes, not its concentration which determines whether or not one becomes intoxicated.

Distillation

The purification of beer by distillation requires at least two stages and sometimes three if all traces of impurities are to be removed. The first stage is known as beer stripping and consists of a rough separation which removes most of the water, all the yeast, and some of the impurities. The second stage continues and completes the purification process, and with less volume to handle and fewer impurities it can be carried out more slowly and carefully.

An analogy would be cleaning up a room after a party: You first get rid of the dirty plates, bottles, napkins, etc., clearing the decks for action as it were, and then you get down to removing the lint from the carpet and the peanuts from behind the cushions. You may even have to go over it a third time if you want a really spotless room. It is significant that two or even three stages of distillation are always carried out in commercial vodka distilleries.

The distillation equipment consists of a boiler of 40 to 50 litre capacity and a fractionating column packed with stainless steel filaments. These are far cheaper and about 5-times more effective than Raschig rings, the reason being that they have a much larger surface area and occupy less space in the column. A small commercially-produced still (see www.gin-vodka.com/GlassStill/) developed especially for amateurs, made of glass and shown mounted in a cabinet, is illustrated in Fig.1. The insulation has been removed from the column to allow you to see the packing of stainless steel filaments inside.

Figure 1. The Saguenay Still

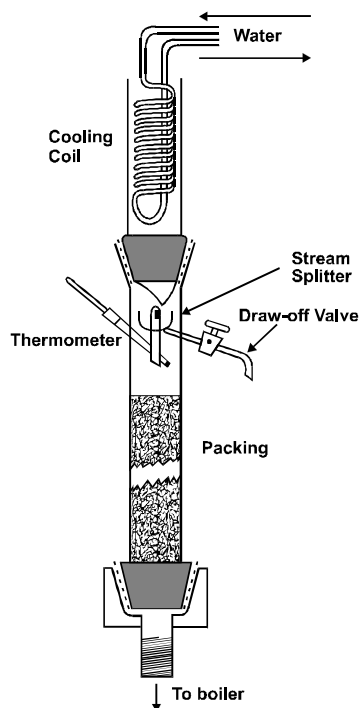


Alternatively, the hobbyist can make his own still by using a small domestic hot water heater as boiler and fabricating the fractionating column from 1 ¼" copper tubing. Complete details of how to make such a still in your workshop is provided in reference (1) but a diagram of a fractionating column is shown in Figure 2 to give you an idea of what it comprises and what the innards are like. We may refer to this diagram from time to time to illustrate some point.

Features of a fractionating column

It can be made from any material which will be resistant to hot alcohol, e.g. glass, stainless steel, or copper. Avoid plastics other than Teflon. The particular model shown consists of a 1 ¼" i.d. column about 3 ft long packed with stainless steel filaments. (For a discussion of packing material see Appendix IV). At the bottom it is connected to a boiler. Above the column lies the vapour condensing system ---- a coil of copper tubing through which cold water runs. Below the condenser and above the packing is a thermometer for measuring vapour temperature and a stream-splitter for dividing the condensate into two streams, one stream being directed to the outside world via a needle valve while the other stream falls back down on to the packing and continues on down to the boiler.

Figure 2. Diagram of fractionating still



The diagram shows a glass column but it could equally well be made of copper. The joints would be different, that's all. With glass there would be standard taper or spherical joints whereas with copper they would be soldered, or a union used for detaching the column from the boiler.

Stage-1 ---Beer-stripping

At the completion of fermentation we have 50 –60 litres of beer which need purifying. With a 40 to 50 litre boiler it is necessary to strip the beer in two separate 25 litre batches. Cooling water is run through the condenser and the boiler switched on. When it comes to the boil it is allowed to reflux for about 30 minutes with the collection valve closed. During this period the volatiles such as acetone and methanol move towards the top and CO₂ in the beer (manifested as foam) is driven off. Don't pour in too much heat at the start while foam is being produced or you'll have it rising up into the column.

Crack open the draw-off valve and collect several tablespoonfuls of distillate, one after another every few minutes, sniffing them to detect the pungent odour of volatile impurities and pouring them down the drain. When the pungency has pretty well disappeared, which means that the heads have gone, put a collection bottle under the collection spout and open the draw-off valve to get a reflux ratio of about 10:1. With a 750 watt heating element the boil-up rate will be about 50 ml/min. so you would be drawing off 5 ml/min (10%), allowing the other 45 ml to run back down through the packing to the boiler. The rising vapour will have its impurities scrubbed out by the descending liquid and carried down into the boiler. The vapour which emerges is virtually pure ethyl alcohol.

During this operation the temperature should remain at about 78° C. throughout. If you open the valve in an attempt to speed up the process the temperature of the vapour may start to rise, in which case you should throttle back and bring the temperature back down to 78°C. If the temperature rises above the steady state it means that there is insufficient condensate running back down the column to effect the purification. As soon as the temperature rises above 78 deg. and nothing you can do will bring it back down again, switch off. It means that all the alcohol has been stripped off. You've finished.

Allow the boiler contents to cool somewhat and then send the stillage to drain. You may wish to tilt the boiler to empty it completely because there will be 7 to 10 litres of stale stillage below the drain valve. Now add the second batch of beer to the boiler and repeat the stripping process. Combine the two distillates which, for want of a better word, are referred to as "high wine". The total volume will be about 4 litres. You are now ready to proceed to stage-2, the high-purity distillation, so drain and flush out the boiler.

Stage-2 ---Fractional distillation

Pour into the boiler the high wine produced by beer stripping and add about 8 to 10 litres of water. There are two reasons for doing this: one is to ensure that the heating element is still covered with liquid at the end of distillation (it mustn't run dry), while the second is that a purer alcohol is obtained when distilling from a dilute alcohol solution than from a concentrated one. This is because the greater the volume of water present the more volume there is available for the impurities to accumulate in.

Bring the contents of the boiler to the boil and reflux for an hour or two with the draw-off valve closed. During this period the column is equilibrating and any remaining impurities rising to the top of the packed column like cream on the top of milk. At the end of equilibration crack open the draw-off valve every few minutes and catch the pungent “heads” in a spoon. Discard. Continue doing this until you can no longer detect any smell (perhaps 20 ml over 20 minutes). Now adjust the needle valve to a reflux ratio of about 10:1, i.e. a flow rate of 4 to 5 ml/min, and collect about 250 ml. Put this to one side for later re-distillation. Even though the pungent smell has gone there may still be traces of impurities so it’s prudent to play it safe. It won’t be wasted because you’ll recover it all when you re-distil at a later date. Then use a clean glass bottle of several litres capacity to collect the distillate, which is now completely pure and ready for use (after dilution) in your vodka martini. Don’t forget to change the collection bottle several times as you near the end so that only the last bottle is contaminated with tails. It means that you have to be present during this final phase, but experience will tell you when to expect the distillation to be complete and when you must start paying attention. Add the last (contaminated) bottle to your discards for later re-distillation.

The output from the still will be the azeotrope ---96% alcohol and 4% water --- which must be diluted to 40% with water to give vodka of normal commercial strength.



The above description is probably too brief to enable you to start making vodka from sugar if you know very little about the subject but is enough, we hope, to give you some idea of what is involved. It’s nothing like as complicated as making beer or wine because the product has no flavour to worry about. And no smell, so you can use that sensitive instrument, your nose, to tell you when you’ve got the right stuff. In any case, any mistakes you make during fermentation or beer-stripping will be taken care of by the second-stage of high purity distillation, and if you mess that up then simply distil a third time.

Flavours & Flavouring

So now we come to the flavouring. As we shall discuss later, the use of commercial flavouring essences to flavour vodka is extremely simple and the range of flavours available is very wide, but it's a bit of a cop-out and if you make your own flavours from scratch using the original fruit or herb itself you will derive satisfaction from knowing that the ingredients you added were the real thing---- fresh and nourishing. You can also use fruits which may not be found in commercial essences --- pomegranates for example! --- Additionally it's a pleasant hobby, like making jam or pickles.

The first thought which comes to mind when contemplating the production of an alcoholic drink by adding flavour to vodka is to emulate a commercial product. These are the drinks we've been used to, have grown up with, and the smart thing to do would seem to be to make exactly the same products at one-tenth the price.

The problem is that it's difficult to copy the flavour of a commercial brand exactly. For one thing, flavours vary from brand-to-brand within a family, so which do you choose? There are dozens of different Scotch whiskies and they are aged in oak barrels for many years. Can you wait?! There are dozens of different brandies and rums. Hundreds of different liqueurs. It's understandable that if you happen to like a particular brand of bourbon you might wish to copy it, but let's think about it for a moment. How did that flavour come about in the first place? No-one started off trying to make that particular flavour --- it evolved from humble origins, probably from something pretty rough, using trial-and-error.

The origin of different flavours

Let's pursue this thought about how the various alcoholic drinks we're familiar with came about, because this will give us a clue as to why a certain brand or a particular country of origin revered by aficionados was developed in the first place. It may also make us question whether we want to follow slavishly in the footsteps of our ancestors or re-think the whole thing. Take vodka for example. Vodka is 40% ethyl alcohol, and because that's *all* it is it makes no difference whether it is made from grain, from potatoes or from milk. Or made in Russia, Poland, Ukraine, New Zealand, N. America or your basement. It is all the same. As the Bureau of Alcohol, Tobacco & Firearms (BATF) in the United States defines it, vodka is "neutral spirit so distilledas to be without characteristic character, aroma, taste or color."

The above statement must be explained because we all know, or have been told, that vodkas can have slightly different tastes, and the distilleries which make them emphasize this in their advertising. It helps them in their never-ending quest to steal a march over their competitors.

How the differences between different vodkas came about is as follows: Very high-purity distillation, in which all trace of impurities can be wrung out of alcohol, is a comparatively recent technological achievement. Years ago the best that could be done was to leave traces of flavour-giving substances, and since these traces were not always pleasant, masking agents were added. These were grasses, herbs, berries and so forth. One such masking agent is bison grass

which grows all over the northern latitudes of Europe and N. America but which is particularly important in the production of certain Polish vodkas (see later).

Nowadays, when high-purity alcohol is easily made, the same flavouring agents may be added in trace amounts, no longer to mask a trace of off-flavour, because there isn't any, but to provide an opportunity for the spin doctors in the advertising departments to do their stuff. You can't easily sing the praises of completely tasteless alcohol. What this means is that European vodkas may all have slightly different flavours. North American distillers seldom take this path so on this side of the Atlantic vodkas are, in general, unflavoured pure alcohol and, if we go by the BATF definition, must be identical. If they are NOT identical then there are only two possibilities: i) they contain impurities left after distillation, or ii) they have been flavoured after distillation. And flavoured vodkas are, by BATF definition, "flavoured vodkas". The generic term "vodka" must be reserved for the really pure, tasteless stuff.

Extrapolating from the above discussion to alcoholic beverages other than vodka, the local beverage would have been made from the handiest and cheapest source of sugar available. Grapes and other fruits would have been a logical choice in France and Italy, while in the Middle East they found, no doubt to their surprise and delight, that milk could be used. (What they didn't know in the early days was that this was due to the 5% lactose it contains.). In the Caribbean the availability of molasses led to rum.

More northern countries had a somewhat limited choice when looking for a source of the fermentable sugars. There were apples, of course, and these were used for making cider, and

In some third world countries the breakdown of the starch in corn is started by the elderly ladies of the village sitting around a large pot and spitting into it. The diastase in saliva is a powerful hydrolytic agent.

honey which was used for making mead, but what could one do with the large amounts of potatoes and grain so readily available? Yeast cannot ferment the ca. 60% raw starch found in grain so our ancestors found, rather cleverly in our opinion, that the starch could be converted into a fermentable sugar (glucose) by treating it with sprouting barley. From that starting point they went on to make what we now call whiskey, or rye, or bourbon.

So the flavours found in alcoholic beverages we buy today came about as a result of trial-and-error and feed-back from consumers, not by design. They evolved. The flavours people liked would sell whereas the really horrible stuff would sit on the shelf. No one deliberately set out to make the different spirits we buy today and take for granted. The early pioneers must have done the best they could, tried it out on their wives and neighbours (and maybe the neighbour's cat), and made a few adjustments. One little thing they found was that water-white spirits (and all spirits are white when first made) seemed to lose some of their harshness when stored in oak barrels. This was particularly true if the insides of the barrels had been sterilized by charring. Charred wood is like activated carbon (although nothing like as good) in being able to absorb the largish molecules responsible for harshness, and being less effective than activated charcoal the spirit had to be left for years. Twelve years for the smoothest products. Charring also renders some of the wood components slightly soluble, enabling the alcohol to pick up a nice brown colour during the aging process.

Taste, or *chacun son goût*

Is there such a thing as a graduated scale of “taste” with good at the top and poor at the bottom? Who draws up this scale? Surely the only criterion from an individual’s point of view is whether he likes it or not. There’s the same problem with food of course--- some people detest Mexican food but others love it, so what does that tell us? It tells us, as the French say, “*chacun son goût*”. We’ve been told that single-malt Scotches are an acquired taste --- you have to study them, read about the craftsmanship which went into their production, pore over the unpronounceable Gaelic names with which they’ve been endowed until eventually you’ll be able to overcome your initial revulsion and pretend to enjoy them. But why, why, why? Mustn’t we use our own judgement? Aren’t we allowed to say we dislike something which self-appointed experts say is the nectar of the gods?

Taste is very, very subjective. Think of drinking champagne from a styrofoam cup or a coffee mug. Would it taste the same? Think of drinking Scotch the colour of water. Would it taste the same? The label on a bottle. The shape of the bottle. The price you paid. The opinion of writers as expressed in magazine articles or sex-and-violence fiction. All these things have a bearing on how the brain reacts and, for all we know, the message which the brain will send to the taste buds.

When designing this chapter it was difficult to decide just where to start, but after a lot of humming and haa-ing it was decided to start with the simplest way to prepare an alcoholic drink, the sort of thing you’d probably prepare day in and day out when you came home from the office, and then move on to the more complicated methods of preparation. So we’ll start with highballs and later deal with procedures which require time, skill and a bit of effort.

Highballs

A highball is a quickly poured drink served in a tall glass with spirits, a soft drink mixer, ice and a twist of lime or lemon. It’s the simplest possible way to use your homemade vodka. For many years now the writer has mixed a vodka and tonic with a slice of lemon every day at drinks-time--- 5:00 PM --- with seldom any variations, and most people seem to operate on the same principle. They have a favourite drink and stick to it. Margaret chooses vodka and orange, called a “screwdriver” if you want to be fancy or happen to be a bartender, but for her it is simply vodka and orange. Every so often, perhaps once a year, she daringly switches to grapefruit juice, a.k.a. a “Greyhound” but soon switches back to the good-old familiar orange juice. Bill swears by vodka and ginger ale and wouldn’t dream of calling it a “Moscow Mule”. Doris likes cranberry juice, because of both the taste and the rich red colour and rarely refers to it as a “Cape Codder”. She just knows what she likes. My wife has a catholic taste --- as she’s fond of saying “if it’s alcoholic I like it” --- but one of her favourites is a Bloody Mary. The recipe for this is:

Bloody Mary

1 ½ oz vodka
3 to 5 oz of tomato juice
1 dash of lemon juice
½ teaspoon of Worcester Sauce
2 to 3 drops of Tabasco Sauce
Salt & pepper to taste

Shake with ice and strain into a glass over ice cubes. Garnish with a celery stick.

Variations on the mixes shown above are virtually limitless. Every conceivable fruit juice or soft drink can be used ---- the colas, pineapple juice, mango ---- there's no need to list them. And of course they can be mixed, e.g. orange juice and cranberry is a "Madras", grapefruit juice and cranberry is a "Seabreeze",



Helpful Hint

The following suggestion will be old hat to many of you but there'll be the odd person who has never heard of it. To avoid having to cut a slice of lemon each time you make a vodka & tonic (or whatever) slice up a couple of lemons, cut the rounds in half, place each piece on waxed paper and place in the freezer. When frozen, keep the slices in a container in the freezer for ready use. They both flavour and cool the drink.

By converting your vodka to gin, rum, or whiskey, etc., either using a commercial flavouring essence or by using classical distilling procedures, you can expand your highball repertoire. As examples, using tequila instead of vodka will give you a Bloody Maria instead of a Bloody Mary, rum and cola will give you a Cuba Libre, gin & Collins mix makes a Tom Collins, while rum & Collins mix makes a Rum Collins. Whiskey of one sort or another, with a twist of lemon, can be mixed with water (surely the ultimate in inexpensive mixers!), soda or ginger ale.

Making Collins mix:

You can buy this in the store or you can make it at home. Collins Mix is:
1 oz. lemon juice, 1 teaspoon of sugar
and 3 oz. of Club Soda.



One can become a little fancier by going to the soft drink section of the local supermarket where you'll find all sorts of sodas, mixers, fruit punches and so on. Just add vodka and you have a pleasant alcoholic drink with a slightly different flavour from your common-or-garden highball. For example, in the small supermarket in our village we came across grenadine, crème de menthe, crème de cassis, peach schnapps, amaretto, daiquiri, margarita and pina colada, and a large store undoubtedly would have more, so flavours are not hard to come by. And then of course there is orange juice, lemon juice, papaya, mango, passion fruit and all those other delectable juices we drink at breakfast-time. Just add some vodka, ice, and a twist of lemon and serve it on the deck before dinner. It's all you need.

Flavoured vodkas

The process involved is known as infusion, which is a fancy way of saying “soaking”. Infusion is very simple. For example, if you like strawberries get some fresh berries and cut them in half. Fill a jar about half full of fruit and pour in vodka to an inch or so from the top (room to breathe). Let it sit at room temperature for about a week, after which your vodka should have the distinct flavour of the fruit embedded in its own. Plus a slight colour. If it is not strong enough for your taste let it sit for another week. If too strong add some unflavoured vodka. When it’s the right intensity, strain through a paper coffee filter.

The same procedure will be used for all the other vast array of fruit and herbs you have available to you, and of course you can mix different fruits or herbs to give a flavour unique to you, e.g. ginger for piquancy, vanilla for sweetness, etc. Basil, oregano, dill, thyme or tarragon (with the stems left on) are all suitable for infusion and provide interesting flavours. There is a commercial micro-distiller in Vermont offering a pink vodka, the colour coming from hibiscus petals, so you can see the sky’s the limit nowadays. People want to experiment with something different so how about rose petals --- colour, flavour and a gorgeous scent!

This book is all about flavoured vodkas, e.g. the use of vodka in highballs, but in this section we are going to talk about vodka which is drunk as such, in a shot glass. Straight up --- and straight down! The way your true Russian or Polish aficionado would drink it. Not made into a highball, cocktail or punch. A true dyed-in-the-wool purist would probably only drink unflavoured vodka, but we’ll leave him to it while we get on with something a bit more interesting.

As mentioned before, most, if not all, European vodkas have a flavour of one sort or another. There are the subtle flavours in trace quantities such as the Zubrovna vodka of Poland, a vodka flavoured with bison grass. And then there the less subtle in-your-face vodkas flavoured with such things as lemon, orange, raspberry, strawberry, vanilla, cinnamon, peach, pepper and so on. Even the famous Russian distillery which produces Stolichnaya is now catering to this new market so they have definitely come of age. They all have the same 40% alcohol concentration as the original but now are much more varied, much more interesting, and give plenty of scope to the connoisseurs among us who wish to go in search of adventure.

Such flavoured vodkas will be sipped as such, in a shot glass, but could of course be used as the starting point for cocktails and highballs. However, if you want a flavour of, say, lemon in your highball or cocktail why not use plain old common-or-garden vodka, which you have in abundance, and add the lemon or whatever to the mixer? It may not taste quite the same but it would be much easier. So in our opinion the most logical way to fully appreciate the beauty of a lightly flavoured vodka is to sip it neat, in a shot glass. Chilled of course, and with some Russian Beluga caviar on a sliver of black bread to nibble between sips.

Bison grass vodka (Zubrowka).



This deserves special mention because it was banned in the U.S. in 1978 due to the BATF having determined that the essence of bison grass contained a chemical which thinned the blood. Eventually, a formulation was developed which still contained some bison grass but satisfied the BATF requirements for health and safety. This chemical, coumarin, is also responsible for the pleasant smell of new-mown grass or hay. Polish vodka flavoured with bison grass is now allowed into the U.S. because the effect of coumarin has been neutralized.

Bison grass, also known as “sweet grass” or “vanilla grass”, is a hardy, aromatic perennial grass (*Hierochlōe odorata*) which grows extremely strongly right across North America, Asia and Europe above a latitude of 40° north. Due to the extensive root system the plants are very difficult to eradicate and many consider it a pest. It is sacred to native peoples in both Europe and North America, the leaves being dried and made into braids or burned as a vanilla-scented incense in peace and healing rituals. It has been reputed to enhance sexual prowess, another possible reason for treating it with reverence.

The following recipes were kindly supplied by Christian von Wechmar of South Africa:

5 to 6 blades of fresh bison grass, 25 cm long
1 teaspoon of sugar
1 litre of 40% vodka.

Cut grass into 3-4 cm lengths and macerate in a bottle of vodka for about 2 weeks. Filter. Add sugar. Place a blade of bison grass in the final bottle for decoration.

You can also use dried bison grass as follows:

10g dried bison grass
170 ml of 50% vodka
420 ml of 95% alcohol
570 ml water
5g (1 teaspoon) of sugar

Make an essence by macerating the dried bison grass in 170 ml of 50% vodka for about 2 weeks. Add 15 ml of this essence to 420 ml of 95% vodka (alcohol), 570 ml water and 5g sugar. (Note by JES. This will produce 40% vodka.)

Bison grass, either in the form of seeds or root plugs, can be obtained in the U.S. from Prairie Moon Nursery (<http://prairiemoonnursery.com>) or in Canada from Sweet Grass Gardens on the Six Nations Indian reserve near Brantford, Ontario. See www.sweetgrassgardens.com

Pepper vodka

Put 2 or 3 small, dried, hot red peppers into about 1/2 litre of vodka in a jar with a large neck and screw cap. Close and allow to infuse for 2 or 3 weeks

Lemon vodka

Use just the yellow zest of two or three lemons and infuse with vodka for a week or two or until the flavour has the right intensity. This is one of the nicest of the flavoured vodkas with a fresh lemony taste.

Liqueurs

Liqueurs were developed in the Middle Ages by alchemists, monks and sorcerers of that period, being used (it is said) as medicines and aphrodisiacs. The reason why a monk should require an aphrodisiac is not mentioned. There are two basic methods for making a liqueur. The genuine, creative method is to steep fruit, spices, herbs, etc. in alcohol, usually vodka because of its neutral flavour (and in our case because it's cheap), then add sugar and seal in bottles. It produces an authentic liqueur which you know contains nothing but natural goodness. The other method (using essences) provides a very wide range of flavours, easily made and in many cases very close in flavour and texture to the genuine article. Here we deal with the classical method of infusion.

There is little point in providing a list of recipes because the procedure is virtually the same for all the various fruits, herbs and spices available. Furthermore, many books have been written on the subject which contain scores or even hundreds of recipes. All we will do here is give a few examples to illustrate how to go about it.



Firstly, though, a couple of tips. 1). Dissolve the sugar in boiling water before adding to the alcohol because you'll find it almost impossible to dissolve the sugar in the alcohol itself; 2) label the jars and bottles with the name and date; 3) store in a cool place away from bright light. When the recipe calls for glucose solids, this is to thicken the liqueur and not to add sweetness. It is easier (and a bit cheaper) to use glucose syrup rather than powdered glucose.

Note: Because there is juice in the fruit and because you are adding sugar dissolved in water, the alcohol concentration of liqueurs is appreciably less than the 40% characteristic of most spirits. It is likely to lie somewhere between 20 and 30%. This should bother no-one because potency is seldom a consideration when liqueurs are passed around after dinner.

We'll start off with a recipe supplied by a correspondent called "Martha", someone we have never met, because it delightfully sums up what this hobby is all about.

Limoncello

"Hi John Stone:

I made limoncello which is an Italian liqueur, but I made it with grain alcohol*. I thought my head was going to blow right off my body. That was at Christmas time and it was only 2 weeks old, so maybe it has developed into something more rational by now. I'm afraid to try it. That's what my friends and family are for. But lemon peel and orange peel are great to use. Also raspberries and the like. I grow black raspberries in my yard so I'll be using them this summer.

My husband has made cherry beer and it is delicious. I'll be trying cherries this summer too. I put sugar syrup in the ones I've made. I don't think I'll be using grain alcohol again, probably just vodka. I'm also going to try plums and maybe it will be something like a brandy. What I'm doing is following the recipe for limoncello but making substitutions. Here it is:

12 lemons
1 liter vodka
2 cups sugar
2 cups water

Pare the zest from lemons --- don't get any white pith. Place the zest into a 2 quart glass container with a tight fitting lid. Pour your vodka over the zest and seal it up. Set it in a cool dark place for 1 week. After a week mix sugar and water in a saucepan over medium heat. Stir till the sugar dissolves and the mix boils. Remove from heat and cool to room temperature.

When it's cool, add it to the lemon peel and vodka, seal it up and store it for another week. After a week, line a funnel with damp cheesecloth, strain your mixture, dividing among clean bottles. Store your limoncello in a cool dark place. Make sure the first container you use is big enough; a 2 quart should do it. Don't use anything smaller.

There you have it.

Martha"

* Note. Grain alcohol is a term often used to describe 96% alcohol (192 proof), the azeotrope.

Raspberry Liqueur

This favourite liqueur has an inviting rose colour and a full fruit taste

3 cups raspberries
15 cherry leaves
2 ½ cups sugar
½ lemon, the yellow zest only
2 ½ cups vodka

Place all the ingredients in a tightly sealed jar and put in the sun for a month, shaking occasionally. Then place in a cool, dark place for 5 more months. Strain through cheesecloth and store in a cool, dark place.

Orange & Lemon Liqueur

This liqueur has a rich, golden colour.

4	oranges, the orange zest only
2	lemons, the yellow zest only
½	lime, green zest only
1 ½	cups sugar
1 ½	cups water
2	cups vodka

Dissolve the sugar in boiling water. Cool. Place all the fruit in a jar with the vodka, add the sugar syrup, close the jar and let stand for 10 days, shaking occasionally. Strain through cheesecloth, seal tightly in jar, and leave for several months in a cool, dark place.

Kirsch

This traditional liqueur is strong, clear in colour and not very sweet.

4 ½	cups unpitted sour cherries
1	cup sugar
4	cups vodka

Cut up the cherries and remove the pits. Wrap the pits in a cloth and smash with a hammer. Put the cherries, smashed pits and vodka in a tightly sealed jar. Let steep for 4 weeks and then strain. Add the sugar and shake until dissolved. Let stand for a week.

Crème de Menthe Liqueur

This liqueur has an appealing mint flavour and is commonly a green colour.

1 ½ cups crushed, fresh mint leaves
1 cup sugar
½ cup water
4 tablespoons of glucose solids
3 cups vodka

Put leaves in a large jar and cover with vodka. Steep for 48 hours and strain. Boil the sugar, water and glucose until dissolved. When cool, add to the mint liqueur and leave until clear. The glucose is a thickener and does not add to the sweetness.

Four Fruits Liqueur

This is not only exquisite and delightful as a liqueur, sipped straight, but is also refreshing when served on the rocks.

2 cups strawberries
2 cups raspberries
2 cups gooseberries
2 cups elderberries or bilberries
1 ½ cups sugar
3 cups vodka

Crush the fruit in a bowl, mix well with the sugar and refrigerate for 5 hours. Transfer the pulp and juices into a jar and add the vodka. Seal tightly and store for 3 weeks. Strain through cheesecloth until clear and store in a glass jar for several months.

Steam distillation

**

Extracting essential oils from plant materials

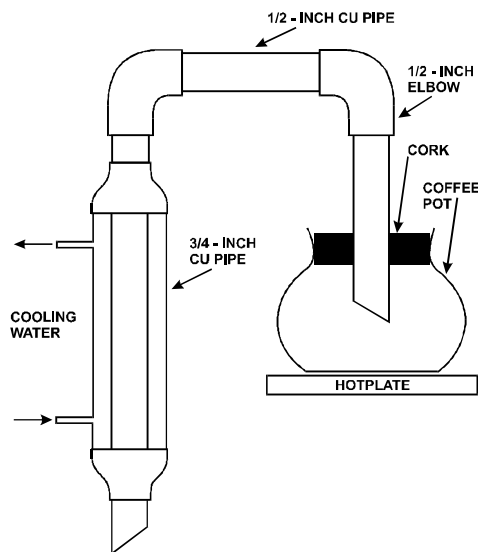
To separate a mixture of liquids which are miscible with one another, liquids such as water, ethyl alcohol, methyl alcohol, etc. the mixture is brought to the boil and the separation effected by taking advantage of their difference in boiling points. Steam distillation is quite different, being used to separate an oil from water, neither of which is completely miscible with the other. Its most common usage is in the extraction of essential oils from a wide variety of plant materials, these oils being used for a number of different purposes, e.g. in medicines, in aromatherapy, and for flavouring drinks.

These oils could also be extracted from plant material by using a solvent such as ethanol, but a general purpose solvent such as this will dissolve a wide range of plant constituents, including colour. Thus, if you extracted juniper berries with alcohol in order to obtain the flavouring agent for gin --- α -pinene --- you would also extract a few unwanted plant constituents, including chlorophyll. This means that your gin would be coloured green! Might make a good talking point at a cocktail party but, generally speaking, people don't want a green martini.

Making gin flavouring essence. A small distiller

Frequently, before describing the mechanics of a technical operation, the theory and principles are explained, the idea being to give you a complete understanding of the process before actually embarking on it. This can be quite boring and off-putting. As an experiment, therefore, we'll try it the other way round, possibly arousing your interest in the process to the point where you might welcome a description of the theory. So we'll start by explaining how to make the flavouring essence used in converting vodka to gin.

The diagram shown below has been copied from reference (1) and shows a simple, home-made still based on a coffee-pot, the reason for choosing a vessel like this being that it has a wide neck for adding and removing the plant material.



The condenser is made from a short length of $\frac{3}{4}$ " copper tubing acting as a cold water jacket around an internal $\frac{1}{2}$ " copper tube. Adapters for connecting $\frac{1}{2}$ " to $\frac{3}{4}$ " copper tubing are standard items and are used for sealing the jacket to the inside tube. Cold water inlet and outlet tubes are soldered to the jacket as shown. A large cork, obtainable from any wine-maker's supply store, is used as lid and has a hole drilled in the centre to take the $\frac{1}{2}$ " copper tubing from the condenser. It looks crude, and it *is* crude, but its saving grace is that it works well and is very cheap. In operation there is very little pressure in the apparatus and no problems are encountered with steam leakage.

The botanicals and water are placed in the flask, either loose or in a muslin bag, and the water brought to the boil. The steam which is generated releases the flavouring constituents from the herbs and carries them over into the condenser in the form of oily drops suspended in water.

As is rather well known the major flavouring ingredient in gin is juniper berries. Articles on commercial gin-making stress the point that the country of origin of the berries is important in determining flavour, as is the time of harvest and the weather prevailing during the growing season. Then the berries are supposed to mature for 18 months after harvest and then used within a critical period of one week! It is all very reminiscent of wine-making and clearly an attempt to introduce a mystique into the operation --- typical advertising hype.

The amateur gin-maker is obviously on his own when it comes to flavouring and is unlikely to duplicate a commercial gin exactly, but if what he makes is pleasing then why worry?

Procedure.

The following recipe gives good results:

- Juniper berries285 grams
- White cardamom..... 15 seeds
- Orris root.....1¼ tsp
- Ground coriander.....1¼ tsp
- Zest of lemon peel..... ¼ lemon. Just the yellow zest.
- 2 ¼ litres watersoft water if possible

- Pulverize the juniper berries in a blender for a few seconds.
- Split the cardamom seeds open and discard the shells. Use only the insides.

- Using a zester, remove the yellow zest from $\frac{1}{4}$ lemon, being careful to avoid the white pith. This pith will impart an unpleasant flavour.
- Place all the ingredients in a 5 litre flask (similar to the little pot still shown in the diagram above, only larger) and bring to the boil. When it comes to the boil, switch off, swirl and let steep for 45 minutes.
- Swirl and bring to the boil. Collect the first 375 ml of distillate in a bottle marked #1
- Collect the second 375 ml of distillate in a bottle marked #2
- Switch off. Distillation complete. Add 375 ml of 96% ethyl alcohol to each bottle. This will dissolve the oily drops in the bottle (the essential oils) and also act as a preservative.

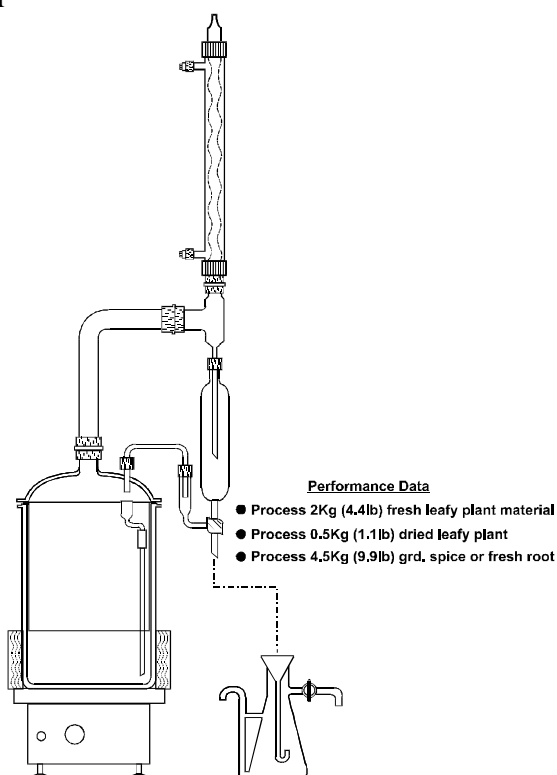
Notes.

- It is best if the juniper berries are fairly fresh. They may sit around in a health food store for years and naturally lose much of their flavour. Ask the store when they'll have a fresh delivery. The berries we use are purchased from Starwest Botanicals Inc. of Rancho Cordova, California, originate in Albania, and are shipped in sealed foil packages.
- To use this essence to make gin, add 15 ml from bottle #1 to 1 litre of vodka. With bottle #2 you may need 20 ml to provide the same intensity of flavour. Quality-wise there's not much to choose between them.
- Between bottles #1 and #2 there's enough essence to flavour about 45 litres of gin.

A larger steam distiller

The little coffeepot distiller shown above may serve to get you started with a small batch using ready-to-hand components, but you may soon wish to operate on a larger scale. The recipe for gin essence above, for example, requires something larger than a coffeepot. The diagram of the steam distiller shown in Figure 3 below was kindly provided by Pegasus Industrial Specialties Inc. of Guelph, Ontario.

Figure 3. Steam distiller



A brief description of the practice of steam distillation was given a few pages back, where we showed how to extract the essential oils (chiefly α -pinene) from juniper berries and other botanicals in order to convert vodka to gin. But steam distillation is not, of course, restricted to juniper berries and gin flavouring --- there is a whole world of plant materials out there containing aromatic and flavoursome oils, and many readers have expressed a wish to know more about the extraction process.

The principle involved is interesting because it is very different from ordinary distillation where we are dealing with miscible liquids and separating them according to their boiling points. Furthermore, several explanations found on the Internet are completely wrong or inexact and need to be corrected.

Principles of steam distillation.

Whereas ordinary distillation deals with the separation of miscible liquids, e.g. water, ethanol, methanol, etc., steam distillation deals with the separation of immiscible or partially miscible liquids, e.g. oil and water. When two immiscible liquids are heated, each exerts its own vapour pressure independently of the other. When the sum of the vapour pressures of the two liquids becomes equal to the atmospheric pressure, the two distil over together, and the

temperature of distillation and the composition of the distillate remain constant until one of the liquids is entirely evaporated.

An example will be given of how steam distillation works, drawn from the scientific literature, using water and chlorobenzene as the two liquids. A mixture of these two liquids was distilled when the atmospheric pressure was 740.2 mm of mercury. The mixture boiled at 90.3° C. At this temperature the vapour pressure of water is 530.1 mm Hg while that of chlorobenzene is 210.1 mm, for a total of 740.2 mm. Chlorobenzene has a boiling point of 132° C., yet when distilled with steam at a temperature 42° C. lower, the distillate contained over 70% of the organic compound.

Another example is aniline (b.p. 183.9° C) and water. Under the standard atmospheric pressure of 760 mm Hg a mixture of these two liquids boiled and distilled over at 98.5° C. At this temperature the vapour pressure of aniline is 43 mm while that of water is 717 mm, for a total of 760 mm. The aniline steam-distilled over at a temperature 85° C lower than its boiling point.

As you can see from these two examples, steam distilling essential oils involves quite a low temperature, thereby avoiding any type of high-temperature degradation.

Whisky, rum, brandy, etc.

Whereas vodka, being pure alcohol, is fairly easy to make and extremely easy to recognise once it has been made successfully, flavoured spirits made in the classical way (i.e. not using commercial flavouring essences) are an entirely different matter. To understand the problems we have to consider where the flavours come from. They come from the plant material of course --- from grapes if we're making brandy, from molasses if we're making rum, or from grain if we're making whisky --- but the flavourful substances are modified during the fermentation process to give additional flavours, resulting in a very complex mixture of hundreds of chemicals. Some of these chemicals will have a reasonably pleasant taste while others will be most unpleasant and even poisonous. Methanol for example. How do we separate the sheep from the goats, the fruity flavours from the paint-remover, that is the question? The answer is --- by trial-and-error, just as our ancestors did. They didn't have a formula. They had no idea what was good or bad because there were no standards and no self-appointed experts standing on the sidelines to tell them when they'd got it wrong (they were fortunate in this respect). They just did the best they could.

Of course we can learn from their mistakes, and we can learn from their successes, but in the final analysis it still comes down to trial-and-error and to one's own subjective judgement as to what constitutes an acceptable flavour and what does not. About the only guidance we can give you is to explain the sort of equipment you need and provide a few guidelines. Then it's up to you.



The problem when distilling for flavour is that there are no fixed points to aim for, no absolutes, no rules nor exact procedures to follow, so there is no way to tell when you've been successful other than by taking a sip, swirling it around in your mouth, and spitting it out. And if the taste is awful it's usually too late to fix it. Success will be strictly a matter of opinion as to what is palatable and what is not, and unless you will be drinking alone it is not just your own taste which matters but also that of your friends and neighbours. As a proud parent who may have given birth to a monster you'll be staunchly supportive of course, but what of your hapless guests!

We have tasted some of the rot-gut whiskey made by amateurs, made carefully and lovingly, and although attempting to be polite while repressing a shudder of revulsion have taken under advisement the statement by the proud hobbyist that "of course, it's an acquired taste". The question we quietly ask ourselves is --- why bother to acquire it? There are so many other drinks available, drinks which are clean and pleasant, drinks which will give you the self-same kick without the slightest hangover next morning, that to force oneself to become inured to a witches' brew of poisons, congeners and alcohol seems to us the height of folly. However, having said that, life is an adventure. We should try everything once, should we not?

From our earlier discussion of distilling you will know that all organic compounds in solution have different boiling points, and we can take advantage of this fact to separate them. At least we can try. Take a look at Table I on page 6. At the top lies acetone with a boiling point of 56.5°C while at the bottom lies furfural with a b.p. of 161.0°C. In practice there are hundreds of other similar chemicals present, and they all blur into one another with no sharp division between them.

The pot still

You will recall that in the case of a simple pot still everything distils over, the first fraction to appear containing the most volatile chemicals with the later fractions containing increasing amounts of the less volatile chemicals. So a rough separation of the components in a fermented substrate can be achieved by simply discarding the heads, collecting the middle fraction and then discarding the tails, one after the other. This is the only control available to the pot distiller.

It's a bit like cutting up a salmon where we remove the head and tail and enjoy the middle slices. Of course, like most analogies this is far from exact because to be exact the slices of salmon would have to continuously change in flavour as we progressed from head to tail. But you get the idea.

The boundaries between compounds of different boiling point can be sharpened, and therefore made easier to separate, by introducing reflux, and the more reflux the sharper the separation. With a simple pot still there is very little reflux of condensed vapour, so the separation of compounds due to their difference in volatility is blurred to say the least. By contrast, if we use a packed column with a lot of reflux there will be almost complete separation. With no reflux we get moonshine. With a lot of reflux we get vodka. To produce a flavoursome brandy, rum or whiskey we need something in between.

In practice, the "beer" is brought to the boil and the first liquid distilling over discarded. Then distillation is continued while the vapour temperature is measured. When the temperature suggests that the vapour is becoming overly rich in high b.p. substances --- i.e. the fusel oils --- the distillation is stopped. In this way you'll have eliminated some of both the heads and tails, and the middle fraction you've collected will be all the better for their disappearance.

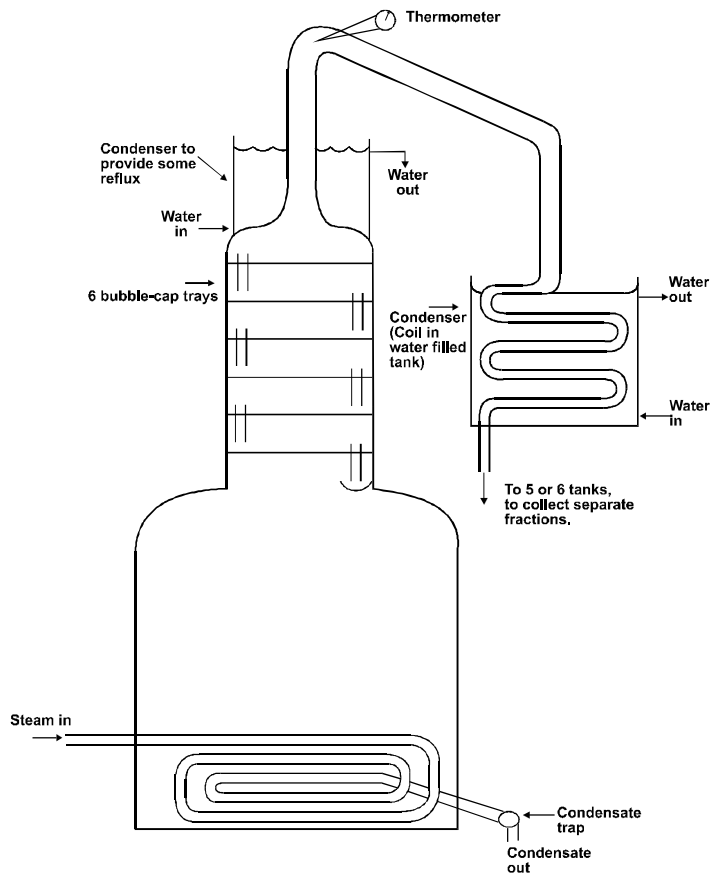
Because water is a comparatively high boiling-point liquid, a lot of it, too, will be left behind with the fusel oils, etc. and consequently the distillate will have a much higher alcohol concentration than the original beer or wine. There will be no more alcohol of course, just less water. Please repeat this to yourself, over and over like a mantra, distilling produces no more alcohol, just less water.

Pot still with reflux

What we have described above is the use of a simple pot still, and this is very inefficient in separating compounds of different boiling points. At the other end of the scale lies the

fractionating still with packed column, and as we know this is capable of giving complete and perfect separation if used correctly. Such a still would lead to vodka, which we don't want. What

Figure 4. Commercial rum still



is needed, and what the commercial distillers of flavoured spirits such as rum and brandy use, is a still which is a compromise between the two extremes of no separation and complete separation.

An example of a commercial rum still is shown in Figure 4 above, taken from the book by John Murtagh (3). Such stills come in different configurations and produce different qualities of rum.

You will see that there is a short vertical section above the boiler containing several bubble-cap trays (just 6 are shown, much less than the scores which a vodka still would contain). Above the trays is another vertical section where some condensation occurs on the walls due to the cooling provided by cold water contained in a surrounding jacket. This rather crude arrangement means that a small amount of reflux takes place, some of the condensate running back down towards the boiler and meeting rising vapour in each of the bubble-cap trays. An exchange takes place, with the less volatile material returning to the boiler while the more volatile material continues up and over into the condensing section. The vapour distilling over into the condensing section has thereby become depleted in high-boiling congeners such as the fusel oils. Note that the condensate is collected in several different receivers, the reason being that the composition of the distillate is constantly changing (unlike our slices of salmon!) and the product found in each receiver will vary in palatability.

Modified fractionating still

If you are making rum, brandy, or whisky, day in and day out, you would use a still such as the one above and refine its geometry from time to time (e.g. add or remove bubble-cap trays) until the product you are getting is what you are looking for. And what you are looking for is something which finds favour with your customers and sells well. If you are a businessman there is no other criterion. It's the only way to know whether or not you have been successful. Customers constitute an enormous taste panel.

If you are an amateur who owns a full-blown fractionating still designed to make vodka, but would like to try your hand at rum and don't wish to build another still, you'll be able to use your fractionating still if you throttle back its efficiency. In that way, instead of removing all the congeners you retain some of them. Your product will then have a flavour. It may be good or it may be bad but it won't be tasteless. There are a couple of ways of doing this. You will remember that, to produce pure alcohol, we used a packed column and a high reflux ratio during the distilling process. This produces hundreds of mini re-distillations in the packing as the rising vapour meets the falling condensate. So the first method for reducing efficiency is to remove some or all of the packing and the insulation around the column, providing conditions similar to the rum still shown in the diagram above.

With the fractionating still design shown in Figure 2 the amount of reflux can be varied from 100% to zero, providing a second method for reducing the efficiency of the column. Simply reduce the reflux ratio from 10:1 to maybe 10:5, which will lead to less separation on each of the bubble-cap trays and allow some of the congeners to distil over.

Taste panel

Since you are not selling your product you won't be able to use the sales figures to tell you whether your whisky or rum or brandy is any good. So you'll have to call upon the help of your friends and neighbours. They'll constitute an informal and unpaid taste panel, rewarded in some appropriate way! Provide each member of the panel with a score sheet such as the one shown on page 9.

After having removed the heads and tails from your concoction, start collecting fractions from the time the heads stop coming over until the tails start to appear and you shut down. Then ask your guinea pigs to rate each fraction. After comparing notes amidst much merriment you may wish to modify your still and procedure and try again on another occasion. Keep all the data in a notebook. Of course you may lose all your friends but it will have been a most worthwhile experiment.

Colouring

No matter what fermented plant material you have been distilling, be it for whisky, rum or brandy, the product will be colourless. Water white. If you happen to know that the commercial product is water-white and you are trying to emulate it then the lack of colour won't bother you. But if you are trying to duplicate a commercial scotch or brandy which has a light brown colour then you or your guests might well be bothered. You won't wish to store your product in charred oak barrels for a number of years we imagine so just add a little caramel food colouring. Even commercial producers resort to this expedient from time-to-time so don't be shy about it.

Commercial flavourings ---Essences

Commercial essences come in such a large range of flavours that, with a supply of vodka ready to hand you can make just about anything you want, and with very little trouble. All you have to do is follow the directions on each bottle, and that usually consists of nothing more than adding a little bottle of flavouring to some vodka. In a few cases the alcoholic base you should use will be whiskey or brandy but generally speaking it will be vodka --- vodka and the flavouring essence. That's it. These extracts (or essences) will be found in most wine-making supply stores and are usually contained in small 25 ml or 50 ml bottles, each bottle providing sufficient flavouring for one litre of the new beverage. The cost will be around \$4 (Cdn.). To this must be added the cost of the vodka, but if you make your own a litre of rum or liqueur or what-have-you will have cost you no more than \$5 or \$6.

The two brands most commonly found in Canadian wine-making stores are those made by Noirof of France and the Royal Piper brand made by the Essence Development Corp. in Canada but the Prestige brand from Sweden is well worth looking for because of the large range of flavours available. Strangely enough, no manufacturers of flavouring essences for alcoholic beverages seem to be located in the United States.

Although these essences are to be found in most beer- and wine-makers' supply stores in N. America they can also be purchased on-line from a number of large retailers, e.g. in the United States look for www.brewhaus.com. To locate a supplier search by brand name, e.g. Noirof, Royal Piper or Prestige. If any of you know of other manufacturers please let us know.

Noirof et Cie Nancy France	EDC Inc. New Westminster, BC Canada	Partyman AB Malmo Sweden
Noirof Brand	Royal Piper Brand	Prestige Brand

Flavours available. The flavours available from the above manufacturers cover just about every conceivable type of drink, from 80 proof spirits such as rum, whiskey, brandy, tequila, etc. to schnapps, liqueurs, coolers, punches, etc. In our opinion, however, it is wasteful to use these essences for drinks which can be made just as easily and more cheaply by simply adding vodka to fruit juice or a supermarket mixer. Where they come into their own is in the conversion of vodka

to a flavoured spirit such as rum, whisky or brandy, or into a liqueur such as Grand Marnier, because in such cases they save a great deal of time, effort and cost. You will understand this by referring back to the previous chapter.

Essences with the Noirot label

These flavours are imported from France where they have been used for many years for flavouring cordials and liqueurs. Each 25 ml bottle of essence comes complete with directions for making one litre of spirit or liqueur. Flavours for spirits and fortified wines include:

Spirits:

B & B	Brandy	Dry gin
White rum	Dark rum	Vermouth (dry)
Vermouth (sweet)	Irish whiskey	Rye whisky
Scotch whisky		

The essences from the different manufacturers are all used in a similar manner but it may be useful to give you a specific example of what is involved by copying the instructions taken right from the label.

White rum (Noirot). 25 ml bottle of essence. Price --- Cdn \$3.75

Ingredients. Water, sugar, artificial flavour

Directions. Add essence to 975 ml vodka. Shake well. Makes 1 litre of rum.

Flavours for a wide range of liqueurs, schnapps and coolers include:

Liqueurs, schnapps & coolers

Amaretto	Dantzick Goldwasser	Peach Schnapps
Apricot Brandy	Floralies	Peach Wine Cooler
Almond, Sweet	Genepy, Yellow (Galliano)	Pina Colada
Anisette, White	Genepy, Green	Raspberry
Anisette, Green	Grenadine	Reverendine
Banana	Hazelnut (Frangelico)	Ratafia
Blackberry	Irish Glen	Raspberry Schnapps
Blackcurrant (Cassis)	Irish Cream (Bailey's)	Rosé Wine Cooler
B-52	Kirsch	Sangria
Cherry Brandy	Kummel	Sangria Blanca
Café Sport (Tia Maria)	Long Island Ice Tea	Swedish Punch
Crème de Vanilla	Menthe Verte	Strawberry Schnapps
Crème de Mirabelle	Menthe White	Scorpion

Yellow Chartreuse
Green Chartreuse
Crème de Mandarine
Crème de Cacao
Chocolat Menthe
Cherry Schnapps
Crème Marnier

Orange Triple Sec (Cointreau)
Orange Brandy (Grand Marnier)
Orange Red Curacao
Peach Brandy
Pear
Peppermints Schnapps

Tequila
Verbena
Yellow Prunella
Yellow Stresa

For the sweet liqueurs such as Crème de Menthe you will need to add 2 cups of sugar syrup (2 cups of sugar boiled in 1 cup of water). For a medium liqueur such as Chartreuse use 1 cup of sugar syrup. For spirits such as Dry Gin and Scotch Whisky use no sugar. Directions are on each bottle so you can't go wrong.

If a recipe calls for glucose you can use white corn syrup instead (3 parts corn syrup = 1 part glucose). Corn syrup is a solution of glucose prepared from starch and is cheaper and more convenient than using the white, crystalline powder.

Note. (January 2003). Although Royal Piper essences may still be found in wine-making supply stores, the company has recently gone out of business.

Essences with the Royal Piper label

These are sold in 50 ml bottles

Spirits

Brandy, Dark Rum, White Rum, Gin, Rye Whisky, Scotch Whisky.

Liqueurs

Amaretto, Anisette, Apricot Brandy, Caribbean Coffee, Café Mexico, Cherry Brandy, Coconut Rum, Crème de Cacao, Crème de Menthe (green), Hazelnut, Irish Cream, Italian Gold, Orange Brandy Cream, Orange de Versailles, Pernod, Peach Cream, Peppermint Schnapps, Peach Schnapps, Sambuca White, Sambuca Black, Scotch Heather, Swiss Chocolate Almond, Triple Sec, Wildberry Schnapps, B52, Long Island Ice Tea.

A specific example of a well-known liqueur with the Royal Piper label, the equivalent of Grand Marnier, is as follows:

Orange de Versailles. Made by Royal Piper. 50 ml bottle. Price --- Cdn \$3.75

Ingredients. Water, propylene glycol, natural and artificial flavours, caramel colour.

Directions. Mix 300 ml sugar, 50 ml glucose, 110 ml warm water and 750 ml vodka. Makes 1 litre of liqueur.

This recipe hardly conjures up a vision of a brandy made in the Cognac region of France, flavoured with a special type of bitter orange imported from the Caribbean. But the flavour is such that if you didn't know where it came from you might well believe that this was "the noble amber liquid of Alexandre Marnier-Lapostolle developed in his laboratory in Neauphle-le-Chateau in 1880."

By and large, sweetish spirits such as rum and schnapps are closer to the original than is the case with dry spirits such as those in the whiskey family ---Scotch, rye, bourbon, etc. Liqueurs, being very sweet anyway, are usually excellent.

The use of these essences presents very little challenge to the would-be genial host, and will occupy very little of his time. He could easily make up a litre each of a dozen different liqueurs, from crème de menthe to amaretto to chartreuse and stick them in the cupboard, to the delight and amazement of his guests. Each litre will have cost him about \$5 for the vodka and flavouring. If, after a while, you find that these liqueurs are not very popular, simply put them back in your still and recover the vodka. That's the nice thing about vodka --- if

you've converted it into something you don't care for, e.g. whiskey, you can always get it back again.

Essences with the Prestige label

This brand of flavouring essence is unique in a couple of ways. For one thing it is made in Sweden, a country better known for luxury cars, tennis players, beautiful actresses and high-quality machine tools than for exotic beverages. Another is that the range of essences is extremely wide, encompassing about 200 different flavours. The Prestige brand is available from distributors in several countries, e.g.

<u>Country</u>	<u>Website</u>	<u>e-mail</u>
Sweden	http://www.partyman.se	strand@partyman.se
United States	www.brewhaus.com	orders@brewhaus.com
Canada	www.brewhaus.ca	mail@brewhaus.ca
Germany (and Europe)	www.geist-im-glas.com	
United Kingdom	www.prestigeessence.co.uk	RespMarketing@aol.com
Australia	www.ibrew.com.au	info@ibrew.com.au
New Zealand	www.spiritsunlimited.co.nz	spirits@xtra.co.nz

The complete range of 200+ Prestige essences cannot possibly be tabulated here, but rest assured that every flavour you can think of is represented, and probably quite a few that you've never even dreamed of, so you should take a look at one of the websites listed above. You're sure to find something to tempt your palate. And as mentioned before, essences are of particular interest when you wish to convert your vodka into quite a different spirit, e.g. whisky, rum, brandy and the like, because this is so much easier and more likely to provide a pleasant drink than any attempt to make them from scratch. A few of the spirit-flavourings available with the Prestige label are listed below.

Spirits. Scotch Whisky, Bourbon Whiskey, Canadian Whisky, Irish Whisky, Dry Gin, Apricot Brandy, Cognac de Luxe, XO Cognac, Puerto Rican Rum, Extra Dark Jamaican Rum, Farmhouse Akvavit, Besk Schnapps, and so on and so forth. And then there are:

Liqueurs. Crème-de-menthe, Strandier (Grand Marnier), Italiano (Galiano), Mia Theresa (Tia Maria), kaffe likor (kahlua), Mississippi (Southern Comfort), Whisky Liqueur (Drambuie). The names in brackets are the commercial equivalents.

References

Books

1. Making Gin & Vodka –*A Professional Guide for Amateur Distillers*. by John Stone
2. The Carriage Still –*An Advanced Fractionating Still for Amateurs*. by John Stone
3. The Alcohol Textbook. 2nd Ed. 1999. Edited by John Murtagh. www.distill.com/murtagh

The Internet

There is so much information on the Internet regarding cocktails, liqueurs, vodkas, etc., etc. that there is little point in us selecting a few in order to save you the trouble of searching. You are much more likely to find what you're looking for by choosing a search engine and plugging in the drink you're interested in, because each search will provide you with dozens of interesting websites from which you can pick and choose.

Appendix I

Effect of pressure on boiling points

The boiling points of liquids quoted in reference books refer to the values measured at a standard atmospheric pressure of 760 mm mercury. As we all know, atmospheric pressure changes, varying considerably from day-to-day as weather patterns change and cold or warm fronts cross the region. Atmospheric pressure also changes with elevation. Not everyone lives at sea level under a stable air pressure of 760 mm Hg so the following table will allow you to interpret any temperature readings you might get in terms of ambient atmospheric conditions.

Pressure					Elevation	Boiling point	
psi	mm Hg	inches Hg	kPa	millibars	Feet	Ethanol °C.	Water °C
16.5	853	33.6	113.7	1137	- 3280	81.5	103.3
15.6	806	31.8	107.5	1075	- 1640	79.9	101.7
14.7	760	29.9	101.3	1013	Sea level	78.4	100.0
13.9	716	28.2	95.4	954	1640	77.0	98.3
13.0	674	26.5	89.8	898	3281	75.6	96.7
12.3	634	25.0	84.5	845	4921	74.2	95.0

Not too many of us live below sea level but quite a few must live at elevations of several thousand feet, and it will be seen from the above table that the effect on the boiling point of ethanol is far from trivial. The same holds true of changes in atmospheric pressure at a fixed elevation, due in this case to the movement of air masses.

You will recall from the discussion of temperature changes during fractional distillation that, after the column has reached equilibrium, the heads are bled off until the temperature remains constant, indicating that pure ethanol is now distilling over. Clearly, to avoid being misled, it is useful to have some idea of what the boiling point of pure ethanol is on that particular day. The table will help in this regard.

Appendix II

Conversion Factors

Throughout the text you will find an awkward mixture of metric units and the foot/pound/gallon system still used extensively in N. America. Different individuals, depending on age, occupation and whether they live in a British Commonwealth country or the United States, will use a different mixture of the two systems. So, for everyone's convenience, a list of conversion factors is provided below.

Volume

1 Imperial gallon	=	4.55 litres
1 U.S. gallon	=	3.78 "
40 fluid ounces	=	1.14 litres
1 fluid ounce	=	28.4 millilitres
1 U.S. quart	=	0.946 "

1 litre	=	35 fluid ounces
	=	0.22 Imp. gallons
	=	0.26 U.S. gallons
	=	1.04 U.S. quarts

Weight

1 pound (lb)	=	454 grams
1 ounce (oz)	=	28.4 "
1 kilogram (kg)	=	2.2 pounds
1 gram (g)	=	0.035 ounces

Length

1 inch	=	2.54 centimeters (cm)
1 foot	=	30.48 "
1 centimeter	=	0.39 inches
1 meter	=	39.37 "

Temperature

32 deg. Fahrenheit (F)	=	0 deg. Celsius (C.)
212 deg. "	=	100 deg. "
General:		
[deg. F. - 32] x 5/9	=	deg. C.

Pressure

1 atmosphere	=	14.7 lbs/sq.in. (psi)
	=	29.9 inches of mercury
	=	760 mm " "
	=	101.3 kilopascals (kPa)
1 psi	=	6.9 kPa

Appendix III

Activated charcoal

An ordinary pot still, the standard type of equipment used by amateurs in the past (and continuing to this day we regret to say) produces moonshine, and this contains some pretty unpleasant things, so activated charcoal remains the only hope of removing some of the worst of them and producing a palatable beverage. By contrast, the alcohol produced by the equipment described in this book should not require “cleaning up” because all the unpleasant things have been removed in the distillation process. Mistakes can happen, however, particularly in the early days before experience has been gained, and when it does one may be faced with a batch of alcohol which is a bit “off”. In such cases a polishing with activated charcoal is likely to be beneficial.

There are several groups of people with a vested interest in promoting the use of activated charcoal in the production of pure alcohol: 1) someone writing about and selling a crude moonshine still; 2) someone who has built a properly designed still, but hasn't yet gained sufficient experience in using it; 3) someone selling activated charcoal; and 4) commercial vodka distillers whose advertising department can play this card in order to suggest ultra-purity.

Does this mean that activated charcoal has no merit? No, it doesn't, but it should only be used when you really need it. Otherwise you're wasting time and money. For example, if someone suggested that you should wear a gas mask on a beautiful spring morning in the countryside, you would have every right to be suspicious. And if then you found that he had a lot of gas masks for sale, your suspicions would be confirmed.

Activated charcoal is used in gas masks, in water purification and in many other areas where small quantities of an adulterant need removal. Its effect is a physical one, not chemical. The adulterant is adsorbed on the enormous internal surface area available. This surface can amount to 1000 m²/gram and is produced in a number of ways but often through the use of superheated steam on ordinary charcoal. The cheapest source is a water treatment company.

To use it, dilute the alcohol from 96 to 40% (vodka strength) and use about 150 grams of charcoal per 6 litres of ethanol. Put into a container, stir occasionally over 5 days, allow to settle and then filter. It is a messy and time-consuming business, although easy enough to carry out.

The very best method of obtaining pure alcohol is to distil it so well in such well-designed equipment that no charcoal treatment is necessary. It is much cheaper and saves an awful lot of time and trouble. We have not used charcoal for the last 18 years and you will find that, with a little experience, you too can dispense with it. Commercial producers of the highest grades of alcohol for use in, say, the perfumery and pharmaceutical industries never use it (3). It's unnecessary. They use a properly designed still.

Appendix IV - Column packing

Raschig rings vs s/s filaments

Fractional distillation for the complete purification of alcohol (e.g. for vodka) requires a tall, narrow column mounted above the boiler packed with small pieces of some inert material such as glass, ceramics, or stainless steel. The purpose of the packing is to provide multiple surfaces where the vapour rising from the boiler meets the condensed vapour cascading down towards the boiler. At each interface in the column there is a mini-redistillation, resulting in pure alcohol emerging from the top of the column while the impurities flow back down towards the boiler.

To achieve the above, the packing material should have the following characteristics: i) the individual pieces should not pack tightly together, but be of such a size and shape that they leave plenty of space for the vapour to rise against the falling liquid; ii) the pieces should have a large surface area and crevices where liquid can be trapped. The most commonly used packing material years ago was Raschig rings, but nowadays stainless steel filaments are much more widely used in small industrial columns because of their greater efficiency.

Raschig rings. First described by Dr. Raschi over 100 years ago, they are a regular feature of small laboratory stills. They consist of short lengths of tubing, usually glass, the length and diameter being the same, e.g. 6 mm x 6 mm.

Stainless filaments. Commercial distilleries which use packed columns frequently employ a product made from s/s filaments woven into a blanket, the blanket then being rolled into a cylinder and slipped into the column. It is so much more efficient than Raschig rings that the column height can be reduced appreciably for the same level of purification.

Originally, just like everyone else, we employed Raschig rings in our columns, but quickly changed to stainless steel filaments when its numerous advantages were realized. Compared to Raschig rings they are: a) readily available from any supermarket; b) one-tenth the cost of Raschig rings; c) occupy just 2% of the space in the column compared to 26% for Raschig rings; and d) have a very much larger surface area available for vapour/liquid interchange. Because of the much greater open space in the column, alcohol production rate can be increased without danger of flooding.

Cleaning. It has been suggested that filamentous packing is difficult to clean. This has not been our experience over 18 years of using such material. After all, the packing is being constantly basted with fresh, hot alcohol, a treatment that would not disgrace the sterilization of surgical instruments, so the maintenance of a shiny surface over many years of use is not surprising. We have never found it necessary to clean our packing and it is as clean and shiny as the day it was installed many years ago. Perhaps those who believe there could be a cleaning problem are using crude pot stills and highly contaminated vapour. It has also been suggested that stainless steel filaments could contain lead, but this is too silly a statement to require comment.

Appendix V

Health and safety

The three major concerns of people who might be interested in setting up a still at home are 1) the question of legality, 2) the possibility of getting poisoned, specifically of going blind, and 3) the danger of blowing oneself up. These are serious concerns, and people take them very seriously. The legal issues are dealt with elsewhere, so here we take a look at the health and safety issues. It consists of a chapter taken from a previous publication (2).

Poisoning oneself.

The belief that there is some inherent danger in distilling one's own spirits is widespread and is reinforced whenever the news media report that a number of people have been taken ill, or even died, as a result of drinking homemade spirits. People associate "homemade spirits" with distillation, with moon-shining, but in fact there is no danger whatsoever in drinking home distilled spirits, or even moonshine properly made. The danger lies in buying liquor from a bootlegger because in order to increase his profits he may top up his moonshine with rubbing alcohol (methanol), or stove oil, or antifreeze or paint remover or any other pungent liquid he can lay his greedy hands on. Naturally such a cocktail is poisonous, but don't be misled into thinking that the toxicity is due to simple ignorance or lack of care on the part of the backwoods distiller. It's not. It's due to these gentlemen adulterating their booze and fobbing it off on an unsuspecting public.

Our recommendation is that you never buy moonshine made in an illegal and unsupervised still, possibly adulterated with unknown chemicals. Make your own if it's legal to do so, in which case there will be no danger whatsoever to your health. This is particularly true of fractional distillation, where you have removed ALL the impurities, but also for simple distillation where you have removed at least some of them. Your equipment will be made of glass, stainless steel or copper, and if made from copper the various parts will be joined with lead-free solder. It would be similar to a Scotch whisky distillery where copper stills have been used for centuries. As for dangers in the distilling operation itself, let us follow this through. Sugar is fermented to alcohol using bakers' yeast to make a crude "beer". No danger so far, right? The beer is boiled and the vapours collected. The first liquid to come over will contain some methanol, acetone and small amounts of other substances which were in the original beer, the so-called congeners. They smell like paint remover and will be discarded. Then comes the potable alcohol which has no smell and is collected for use. Finally there arrive the fusel oils with a somewhat unpleasant odour so they, too, are discarded. Remember, the distillation has not created anything, it has simply separated out the noxious substances from the beer --- the heads and tails --- allowing them to be discarded.

So, to poison oneself, it would be necessary to remove the congeners from the beer by distillation, pour the purified alcohol down the drain and then, ignoring the pungent smell and

sickening taste, drink the paint remover. This is about as likely as plucking a chicken, throwing away the meat and eating the feathers. It strains credulity to put it mildly.

Headaches and hangovers

Headaches and hangovers are well-known consequences of over-indulgence in alcohol, but what is far less well known is that these unpleasant side-effects are largely due to the impurities, the congeners, and much less to the alcohol *per se*.

This interesting fact will be confirmed by many people who habitually drink gin or vodka rather than pot-distilled spirits such as rye, bourbon, scotch, rum or even wine and beer. More objective proof that the congeners and not the alcohol are the bad actors can be found in the scientific literature. Numerous studies have been made and all investigators find the same thing, i.e. that the symptoms of hangover --- headache, halitosis, gastric irritation, fatigue and dizziness --- were far more severe when the same amount of alcohol was consumed in the form of whisky than in the form of vodka. When you think about it, this is hardly surprising considering the poisonous nature of some congeners.

As an example of such studies, in one clinical investigation 33 men and 35 women were each given 2 ounces of either whisky or vodka on separate occasions. The incidence of after-effects in the group following a single drink of 2 ounces of whisky was halitosis 27%, gastric irritation 25%, headache 9%, dizziness 7% and fatigue 6%. These symptoms persisted during the following day. After the same amount of vodka, temporary headache and gastric irritation were observed in only 2% of the subjects while there were no complaints of halitosis, dizziness or fatigue in any of the cases. It should be noted that all the subjects in this trial were light social drinkers.

The effects described above were produced by a commercial whisky in which the congeners occurred to the extent of about 3%. As part of the study the congeners were separated from the whisky and given to the subjects in the absence of alcohol. The effect was the same as when the whisky itself was imbibed, proving that the congeners and not the alcohol were responsible for the adverse reactions. The chief culprit among the congeners was considered to be one of the fusel oils --- amyl alcohol --- and not methanol as might have been expected.

These results are not really definitive --- for one thing the size of the sample was rather small --- but even without such a trial it is not difficult to believe that drinking such things as methanol and fusel oils, even in small amounts, will be bad for you. If it were a different poison, e.g. arsenic, it would not be surprising if a 3% solution in alcohol, or even in water, gave you an upset tummy. 3% is not a trivial amount when one considers that nowadays the authorities are concerned about parts per billion of contaminants in foodstuffs.

One of the conclusions to be drawn from such studies is that whisky production should be handled carefully by amateurs. As mentioned in an earlier section, pot-distilled spirits involve the retention of some of the congeners in order to give taste to the whisky, but some of these taste-providing congeners are poisonous so don't overdo it. It would be wiser, perhaps, and certainly easier, to remove all the impurities by fractional distillation to give a pure alcohol and

then add a flavouring agent. The physiological effect of an alcoholic drink, the 'buzz', is due solely to the alcohol, and everything else is merely moonlight and roses! (To coin a phrase!).

A final comment concerns the question of alcohol concentration in beverages. In beer the concentration is about 5%, in wine it is 8 to 13%, while in distilled spirits it is usually 40%. Only a moment's thought is required to appreciate that the concentration of alcohol in a drink is irrelevant, it is the amount consumed which is the determining factor in determining whether or not someone becomes inebriated. Drinking a bottle of beer is not less harmful than a 1½-oz. drink of 40% scotch just because it is weaker. They both contain identical amount of the same alcohol, i.e. 17 ml. Adding tonic water to a shot of gin dilutes it from 40% to maybe 6% but this has not rendered the gin less intoxicating --- the amount of alcohol has remained unchanged.

This is all so obvious that it may seem a little absurd to even mention it but, in most countries, the concept appears to be somewhat too difficult for the official mind to grasp. This is shown by the fact that governments put a much higher tax per unit of alcohol on distilled spirits than on beer and wine. The reason for doing this, it is claimed (somewhat piously) is to discourage people from drinking something which could be harmful to their health. A more likely reason is that they see it as an opportunity to increase tax revenue. If a government wished to base their tax grab on a rational argument they should start by basing it on alcohol amount (so much per unit of alcohol) instead of on alcohol concentration. And then, if health were the primary consideration as they claim, an additional tax would be levied based on the amount of poison (congener) present. Vodka would then attract the lowest tax of all and we would all live happily ever after!

A final note for environmentalists and watchdog groups on health matters: Is it not time to demand that governments require all manufacturers of alcoholic beverages to list the composition on the label? This would enable us to choose the ones with the lowest levels of toxic ingredients. They do it for food so why not for drink, particularly for drink which is *known* to contain several poisons.

Fire and explosions.

This may sound a bit melodramatic but when you are dealing with a procedure for the first time, and know that alcohol is inflammable, you may wonder. Let's take the explosion issue first. At no time, from beginning to end, is there any pressure in the equipment used for distillation. It is always open to the atmosphere. Fully open. Completely open. You will see that this is so when you look at the diagram of a still and read a description of the procedures involved. So don't worry about it --- an explosion is impossible.

As far as fire is concerned you are dealing with an aqueous solution of alcohol which is non-inflammable right up to the time you collect the pure 96% alcohol dripping from the draw-off valve. This is inflammable, but most people will be using an electrically heated boiler so there is no open flame. Secondly, in the remote possibility that a fire occurred, alcohol fires can be instantly doused with water because alcohol and water are miscible. For this reason it is much

safer than gasoline, and in the fuel alcohol industry this fact is always quoted as one of the benefits associated with ethanol when it is used alone as a fuel --- in Brazil for example.

Appendix VI

Myths Surrounding Home Distilling

The commercial distilling of spirits is thought of by our old friend the-man-in-the-street (assuming he thinks about it at all) as an activity carried out by chemical engineers in huge distilleries far removed from everyday life, conjuring up an image of alchemists, necromancers, and unholy forces at work. And as for home-distilling.....! Well!

Home distilling suffers from an exceedingly bad press. For many people it is on a par with counterfeiting, wife-beating and child abuse! Sleazy in the extreme! Something no decent law-abiding citizen would ever dream of doing. Also dangerous. This feeling is so ingrained in the social psyche that the law which prohibits it has become self-policing.

By contrast, beer- and wine-making are seen as wholesome, bucolic activities handed down to us from long ago by poets, shepherds and simple country folk as they played their flutes and danced around the Maypole.

The curious thing about all this is that whereas both beer-and wine-making involve the production of alcohol, distilling doesn't. Not a drop of alcohol is made during the distillation process --- never has, never will, and is incapable of doing so. Alcohol is made by fermentation, not by distillation.

So what's all the fuss about? What's behind this curious distinction between beer, wine and spirits? The root cause of it all is the sad fact that government officials are incapable of distinguishing between *concentration* and *amount*. Actually, many people have this problem, but with governments the consequences of ignorance are severe. It has led to the suppression of an innocuous hobby, to the imposition of crippling taxes on spirits, and to restrictions on advertising and sales outlets.

With the advent of the Internet people can no longer be fobbed off with a load of codswallop. To help this process along we'll supply you with a few facts about distillation and dispose of a few myths at the same time.

Technical. Distilling involves nothing more than boiling a "beer" and collecting the vapour on a cold surface. Not a drop of alcohol is made and, in fact, a little is lost. The alcohol will be more concentrated it's true (some water has been removed) but there's no more alcohol. *Nothing* is added during distillation so there can be nothing in a distilled spirit which wasn't in the original beer.

Beer and wine contain a multitude of chemicals, some of which are poisonous but which in low concentrations do no more harm than provide you with a splitting headache the following morning (if you've over-indulged). When the beer (or wine) is boiled the vapour contains all these compounds, both good and bad, but due to their different boiling points it is possible to

separate them and selectively remove the worst ones. This, in fact, is the very first step taken by distillers --- they bleed off the volatile methanol, acetone, etc. and pour them down the drain. Following this, the distillation can be controlled to retain or reject any particular chemical and thereby modify the flavor. If all the non-alcoholic components (known as congeners) are removed from the beer you get pure ethyl alcohol which, when diluted to 40% with water, becomes vodka. By removing some, rather than all, you get whiskey, or brandy, or what-have-you. Whatever the spirit produced, the methanol, acetone, fusel oils, etc. have been removed, resulting in a far less toxic beverage than either beer or wine. More concentrated but less toxic.

Health. As far as is known, there is no recorded example of someone being poisoned by home-distilled spirits. It is a myth. So how does one explain the stories one hears about individuals or families being poisoned and dying as a result of consuming “moonshine”? It was not caused by the distillation, that’s quite certain. What had happened was that some unscrupulous moonshiner had topped up his liquor with rubbing alcohol, windshield washer, paint remover, anti-freeze or any other pungent liquid he could lay his greedy hands on in order to increase his profits. Home-made and home-distilled are two very different things, but there are those with an ax to grind who will try to frighten you into believing they’re the same.

Social. Strong drink! Demon rum! Whiskey has eight times as much alcohol per unit volume as beer so it stands to reason that it is eight times as dangerous. Right? Just think about it. Have you ever heard of someone drinking a 12 oz. can of 40% spirits? Ridiculous! Don’t forget that the riotous behaviour so characteristic of football hooligans in Europe is the result of drinking can-after-can-after-can of 5% beer until the *amount* of alcohol consumed is very large. 5%, not 40%. It’s the *amount* you consume, not the *concentration* which counts. It’s so obvious. Remember too that the vast majority of people pulled over by the police for drinking and driving have been drinking beer, not spirits. Alcohol concentration has nothing to do with it. It is the testosterone concentration which causes problems!

Financial. The fear that commercial distillers would lose sales, workers lose their jobs, and governments lose tax revenues if amateurs were allowed to distil their own spirits is a major concern of governments. And particularly the loss of tax revenues, the thought of which brings government officials out in a rash!

The fact is that in New Zealand, in the years leading up to the lifting of the ban on home distilling (1996), sales of spirits had been steadily declining. The same is true of many other countries. In Canada, for example, in the last 20 years the sales of spirits have been cut in half, and this at a time when the population was increasing. But it was found in New Zealand that, as soon as amateurs were free to distil their own spirits, there was an immediate and steady rise in commercial sales. Sales went UP not DOWN! (And there was a consequent rise in tax revenues of course)!

The reason for this surprising turn of events is attributed to the upsurge in interest in spirits as soon as it became a hobby. It was no longer a remote commercial enterprise but something for fun-loving youth and hobbyists to get their teeth into. The realization that hobby distilling poses no more problems than beer- and wine-making and should be afforded the same rights and freedoms is finally taking hold, the most notable example of this being in the United States where a bill has been tabled in Congress by Bart Stupak of Michigan (Bill H.R. 3249)

which seeks to remove the current restrictions on home distilling. And when this legislation goes through one would hope that other governments around the world will take notice and begin to question whether possibly, just possibly, they have been wrong all these years.

Appendix VII

The Principles of Fractional Distillation

Distillation separates the various compounds formed during fermentation by using the difference in their boiling points. The boiling points at standard atmospheric pressure of some of the more important chemicals found in the beer produced by fermenting sugar with yeast are shown in Appendix II.

When a mixture of these compounds is boiled in a simple pot still the vapour is found to contain all the components which were in the mother liquid but enriched in the more volatile ones. The first fraction of vapour distilling over is referred to as the “heads”. There is no clear-cut separation of the various compounds, so the “heads” are still coming over when the ethanol starts to appear in increasing amounts. Similarly, before all the ethanol has distilled over, the “tails” will begin to appear in the distillate. These tails are the compounds at the lower end of the table; i.e., those with the highest boiling points, such as propyl, butyl and amyl alcohols. These alcohols are known collectively as “fusel oils” and, like methanol and some of the other compounds, are quite poisonous.

In such a system there may be a tiny fraction in the middle which is pure ethyl alcohol, but most of it will be contaminated with either heads or tails. One could discard the first heads and the last tails and re-distill the middle fraction, repeating this process over and over again until the last of the impurities had been wrung out of the ethanol. Unfortunately, apart from being very time-consuming, the loss of ethanol on repeated distillation would be such that the final yield of pure alcohol could be virtually zero.

Fortunately, it is possible to overcome this problem by the very elegant procedure known as fractional distillation. In fractional distillation the vapour emerging from the boiler passes up a column packed with small pieces of glass, ceramic, stainless steel, or other inert materials. Each of these pieces can hold a small amount of liquid, either internally (if they have internal crevices) or in the interstices between adjacent particles. Above the column lies the still-head where the emerging vapour is condensed into a liquid by means of cold water running through a heat exchanger. Initially, instead of being collected, all this condensed liquid is allowed to run back down through the packing in the column towards the boiler.

At equilibrium, which may take several hours to achieve, the system consists of vapour rising up the column meeting a flow of liquid running down the column. At each vapour-liquid interface on the packing material within the column a partial separation occurs wherein the more volatile components of the mixture go into the vapour phase and rise to the top, while the less volatile components go into the liquid phase and are carried down towards the boiler. This, at equilibrium the many components in the mixture become stacked up in the column in the order of their boiling points, the most volatile at the top and the least volatile at the bottom.

Above the column lies the still-head containing the stream-splitter. This is where the condensed vapour dripping from the cooling coil is separated into two streams. One stream can be directed to the outside world for use while the other stream is allowed to flow back down through the packing. After equilibrium is established, the heads which have risen to the top (the acetone, methanol, etc.) are bled off and discarded. They are very pungent and highly inflammable.

After the heads are all gone, a reflux ratio of about 10:1 is established by opening the draw-off valve an appropriate amount. In this state, 10% of the total reflux is drawn off to the outside world for use while the other 90% is allowed to continue down through the packing to continue the multiple mini-distillations and the purification process. When all the ethanol is gone the temperature in the still-head will rise rapidly, announcing that the recovery of pure ethyl alcohol is complete.