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CIDER
Historical notes and technique

Introduction

Cider is a drink that was produced since antiquity. The cider-term generally refers to the product of the alcoholic fermentation of the juice of some pome (***Malus communis, Malus domestica, Pirus communis sativa***), or some stone fruit juice (***Prunus avium, Prunus cerasus, Prunus mahaleb, Prunus domestica, Prunus spinosa, Prunus insitita, Prunus padus***), or some other small fruits (***Rubus idaeus,Rubus fruticosus, Fragaria vesca***). The most famous cider is without doubt that resulting from the alcoholic fermentation of apple juice.

The word 'cider' is derived from the Hebrew "***shekar***" (drink), the greek word was "***sikera***" and in Latin it became "***sicera***". Even in Old French there is trace of a drink called "***cisdre***". Paradoxically, the word ***"cider"*** appears in England, land of ancient traditions linked to cider, only in 1200 A.D., when the indigenous tannic and bitter apples were added to the varieties imported from continental Europe. In our country there is a real distrust of the production and the consumption of alcoholic beverages obtained from fruits other than grapes. This is probably due to the exuberance of wine production, from its countless varieties and higher alcohol content than cider. In other European regions alcoholic beverages derived from alternative grape fruits were produced from immemorial time for ease of retrieval of the fruits and the geographical limits of the wine culture. The tradition of cider is therefore completely European center, that with the exception of the north eastern mountain areas, excluded our country.

The French distinguish cider in ***"cidre",*** produced from apples, and ***"poitrè"*** obtained from pears. German cider is defined "***apfelweine***". The Spanish term ***"sidra",*** produced in the northern mountainous areas of the Iberian Peninsula. In the United States the words ***"fresh", "sweet", "hard"*** and ***"farm cider"*** refer to fermented apple juice. Cider is an amber colored, slightly alcoholic beverage, sour and often astringent, with a pleasant scent that can follow even special processes: a flexible beverage short, characterized by distinct and different flavors by varying the quality of apples used.

History

It is difficult to determine when and where this drink was first produced and consumed; it is certain that it has ancient origins. Referring to 2800 BC the Bible documenting how Jews used routinely mix honey with cider.

In ancient times in northern Europe cider was the only alcoholic beverage fermented together with the beer called at the time "***cervogia***". Most likely became for the people Gallic of Saxony and for the Celts of Britains a fine drink reserved for special occasions, both for the upper alcohol content and because it could only be produced in the collection of fruits. According to the Celtic culture recipes for cider and mead they were in the hands of the priests (***druids***). The cider was not only a beverage with high organoleptic qualities but was valued for its refreshing qualities, energy and antiscorbutic. Even the Romans appreciated the Gallic cider in their boarding schools and in the early centuries of the Christian era learned to produce it themselves. Columella, Latin writer who lived in the first century A.D., treated, in its "Rural Economy", of the pear wine making, which we call cider.

In the Middle Ages, this drink did not lose its value so much that, despite being well known, was not at all popular. The cider was consumed in the abbeys and in the courts since 1100, but until 1700 the beverage consumed by the people was the beer. Following a famine occurred in 1259, it was banned in France the production of this popular drink because of excessive consumption of cereals and from this date began the "age d'or" of cider; Also in the '300 Charles IX made destroy a part of the vineyards to turn them into arable land to barley and wheat. It is documented that from '400 to ‘800 regions planted with apple trees for cider reached considerable size. Even the famous Dom Perignon, the inventor of Champagne, in 1683 it would be inspired by the experimental production of a fortified cider sucrose to get more flavor and make it more exciting. Even in England the development of the cider production started in this period, as documented by the time detailed texts on the principles of the fruit crop. Only at the beginning of this century with the population growth, the increase in transport and the opening of a marketplace developed research on the fermentation process so far unknown; institutions arose as Caen and Rennes in France, in Switzerland Wadenswil, Geisenheim in Germany and Long Ashton in England, that identified many of the causes of abnormalities fermentation of must and they spotted possible treatments. This trend stopped in the 40's when, because of World War II, the French and English governments were forced to commandeer apples for the industrial production of alcohol: rewarding the producers of cider with lavish subsidies the production was oriented towards this destination. After the war, the cider production did not resume its original style and went diminishing identifying themselves more and more as a handicraft and limited production. Only since the 60s with the development of tourism on the Atlantic coast and the ecological trend cider was relaunched towards industrial production.

Spread of cider

The cultivation of grapes has very specific geographic limits beyond which viticulture is difficult, 50 ° north latitude and 600 m above sea level. This justifies the widespread nature of the apple tree in northern center of Europe. Apart from the aforementioned countries cider it is produced in North America (Northern California, Oregon, Washington), in Canada (Quebec, New Scotland) and Russia. They do not know the precise amount of product cider since statistics are almost non-existent. Even in the southern hemisphere it is starting to produce unfermented juice and cider starting from the surplus of apples as evidenced by some reality in Australia and South Africa. In Italy there are very limited artisanal cider production in mountainous areas of the northern regions.

The apple

Already in the Stone Age the Malus sylvestris was cultivated as evidenced by the archaeological remains found in the Central European area. The origin of this plant is Caucasian, as demonstrated by the Swiss botanist Augustin Pirame de Candolle in his book "Origine des plantes cultiveés". In 2000 BC some Egyptian archaeological findings testify to the apple growing in the gardens on the Nile Delta and some documents prove how the pharaohs Ramses II and Ramses III it should offer the fruits to the priests of Thebes. some Greek authors also give information about the different varieties and the agronomic techniques to improve their productions. The Romans, as written by Plinio il Vecchio in his "Historia naturalis" of the first century BC, forty cultivated apple varieties. Some Roman documents describe how the Gauls cultivated apple trees in the middle of the Norman forests; The druids, in fact, believed that it was sacred trees the same way as oaks.

The apple is a false fruit also called pommel or melonide, roundish, compressed or stretched, with stalk sunken and calyx bracts persistent, at the opposite end which also has a cavity. The constituent parts of the apple are:
the Pericarp: also called epicarp or peel, it is more or less pigmented, thin, durable, shiny or matte, smooth or rough
the Mesocarp: (pulp) is swollen, fleshy, with sour taste and / or sugar. It represents the storage site of the fruit
the Endocarp: is central, with five cartilaginous lodges, it represents the "container" of the seeds that are found in amounts of one or two for each lodge as in floral stage contains two ovules in each of them.

The varieties are propagated by grafting since the genetic characteristics can not be fixed by heredity. Now the result intended as vehicle propagation can elicit a modest interest only for the production of rootstocks francs or to keep a certain hardiness in marginal varieties.

The variety

The cider is obtained by crushing of different varieties of apples, cider, cooking and occasional table. In our country abound varieties table but do not know varieties of cider or at least grown as such. What characterizes the latter, from the organoleptic point of view, it is the bitter and astringent taste due to the high concentration of polyphenolic compounds (tannins) which give the body cider and aroma; the high acidity that gives the cider freshness and shelf life is also remarkable. According to some authors it was the bitter Malus species that gave rise to the varieties of cider. The ability of cider producer is to create an appropriate balance between the three characters: sweet, sour, bitter, blending more varieties of apples. In the "traité du vin et du cidre" of 1589, Julien Le Poulmier, doctor of Charles IX, talks about eighty varieties of "pommes sures" (sour) and "pommes doulces" (sweet) whose different quality characteristics gave cider countless organoleptic nuances.

The British cider makers distinguish apples that use in:
Sweet: tannin powder and low acidity, provide a mild juice suitable for cuts with juices from stronger taste.
Bittersweet: rich in tannin and low acidity, give an astringent juice to taste.
Bittersharp: rich in tannin and acidity of the apples of this group with milder taste can be used alone for the production of cider but is unusual practice.
Sharp: tannin powder and rich in acidity, they are used to acidify the cider.

Varieties	Malic acid %	Acidity g/l	Polyphenols %	Tannins g/l
Sweet	0.20	< 4.5	< 2	0.14
Bittersweet	0.20	< 4.5	> 2	0.30
Bittersharp	0.60	> 4.5	> 2	0.26
Sharp	0.70	> 4.5	< 2	0.12
Cooking apples	0.80	0.08		
Table apples	0.45	0.06		

The French ciders are elaborated from musts derived from apples whose acidity never exceeds the 2.7 g / l of malic acid. Since the cider production started to lose ground (early '900) it has not been made any genetic selection on the varieties of cider so they are all ancient. Only since the 80s some hybrids have been put in market. Considering further the cider apples we can mention the characteristics of some of the most used varieties:

Variety	Malic acid g/l	Tannins g/l
Sweet Coppin (sweet)	2.1	1.4
Dabinett (bittersweet)	0.20	0.30
Yarlinton Mill (bittersweet)	1.8	2.9
Kingston Black (bittersweet)	5.8	1.9
Stone Red (sharp)	6.4	3.1
Brown's Apple (sharp)	6.7	1.2
Tom Putt (sharp)	6.7	1.4
Golden Delicious (table apples)	8.5	0.8
Bramley's Seedling (cooking apples)	4.5	0.6

In France the classification is based on the age of maturity which is associated with the degree of the pulp consistency:

1) Early or tender: ripen in late September - early October; They are mealy, sensitive to damage from handling and easily attacked by microorganisms. They are also called "pommes tendres" and must be processed immediately.
2) Mid-season or semi-hard: mature in October - mid-November; They stand up well to transport and should be kept in stock for a few weeks to complete their maturation. They are also called "demi tendres".
3) Late or hard: ripen in mid-November – December; they are better at handling and transport on condition that they are perfectly healthy harvest. They are called "pommes dures".

It is not possible to give here a complete picture of all varieties of cider authorized by agriculture departments of France, England and Germany, we mention some of those included in the lists of recommended varieties:

Ripening	**France**	**England**	**Germany**
early	Doux Josefph	Tremlelstt's Bitter, Tayolr's, Somerset Redsteak	Winter Winesap, Bramley's Seedling
medium	Antoniette, Binet Rouge, Cartigny Chevalier, C'Huero Briz, C'Huero Ru, Clozette, Donaines, Doux Eveque janné, Doux Veret de Carrouges, Mettais, Paul de Chien, Douce Moen, Armagnac, Avrolles Blanchet, Jaune de Vitré, Lacord blanc, Lacord verd, Sebin.	Michelin, Yarlington Mill, Dabinett, Chiesel Jersey	RoterBoskop, Bitterfelder.
late	Doux Normandie, Martin Omfroy, Rouge Duret, Tardive de la Sarthe, Judin Pomme de Bonet.	Vilberie, Brown Sat	Basthlinger Weinapfel, Cardinal Bea.

Other varieties grown in the U.S.A. are "Blue Permain", "Newton Pippin" and "Russet Doreé"; They are varieties nineteenth century, late, aromatic, bitter, hard and juicy flesh.

It is important that the fruits are not dented with the harvesting operations in order to keep them healthy until the transformation. In mechanical harvesting using shakers that move the tree alternately by dropping apples on a foam layer or an elastic net. Generally the yield in juice should not be less than 70%.

Production system

The cider production techniques vary according to the work system: traditional or artisanal and industrial. These two methods are added the different ways of producing cider linked to local traditions and the demands of the consumer. Despite the qualitative heterogeneity of raw material influenced by soil and climate and cultural factors, the manufacturer directs its efforts to obtain a product as more standardized and stable as possible.

Organoleptic composition of the juice

It is influenced by the annual climatic variables and the degree of maturity of the fruit to press.

Components	Fruits in the process of accumulation	Ripe fruits
Total sugar g/l	40	120
Reducing sugars g/l	23	58
Sucrose g/l	5	57
Solid residue g/l	136	160
Starch g/l	40	2
Malic acid g/l	16	2

During storage, in which the ripening continues, there is the hydrolysis of cellulose and starch, the formation of soluble pectins and inversion of sucrose. In the ripe apple the relationship between the fructose and glucose is 2: 1 or 3: 1.

The juice characteristics

Water:	94.9 - 98 %
Density	1.045 - 1.061
Soluble solids	< 150 g/l(80 % sugars + 20 % organic acids, nitrogenous substances, aromas, vitamins, salts)
Sugars	fructose 60 g/l, glucose 15-20 g/l, sucrose 25-35 g/l (It undergoes reversal due to pressing environmental acid), D-xylose 0.5 g/l, traces of galactose
Organic acids	malic acid 1-13.6 g/l, chemical acid 0.4-4.6 g/l, ascorbic acid 23-36 g/l, citric acid 0-0.2 g/l, tracks: citramalic acid, lactic acid, succinic acid, shikimic acid, galacturonic acid, chlorogenic acid and caffeic acid
pH	3.2 - 4.4
Nitrogen compounds	total nitrogen 44-330 mg/l; It is represented by proteins (which denature at the extraction of juice combining with the tannins), by amino acids (which play an important role in the growth of yeasts and bacteria), by pyrimidines and nitrates. The main amino acids are: asparagine, aspartic acid and glutamic acid
Tannins and polyphenols	0.8-5.4 g/l. They are associated with the astringency they are causing combining with ptyalin (protein with enzymatic action amylolytic present in saliva). In reality, only the group of procianidrine combines associated with this phenomenon. The part of the polyphenols of apple juice is made up of phenolic acids, ethers quinic acid (chlorogenic acid), catechins, floretine, procianidrine condensed
Aromatic components	are numerous, alcohol and ester extremely volatile and at low concentrations
B Vitamins	biotin 2.5 microg/l, pantothenic acid 500 microg/l, riboflavin 50-500 microg/l, thiamine 200-600 microg/l. They are all important for the growth of yeasts and bacteria
Mineral salts	calcium 100-190 mg/l, magnesium 60 mg/l, phosphorus 35-260 mg/l, potassium 440-1630 mg/l
Pectins	polymers of galacturonic acid partially esterified by methyl alcohol and salified by calcium and magnesium. They are compounds that join the walls of the fruit of the cells and pass into the juice during the extraction phase. They cause turbidity as are the protective colloids and are defecated in the form of pectates (calcium pectate)

Microorganisms yeast and bacteria

On the surface of mature fruit are present yeasts included in the genres: Aureobasidium, Torulopsis, Hansen*ula, Pichia, Candida, Rhodotorula, Debarimyces, Kloekera, Saccharomycodes*. Species of the genus *Saccharomyces* are rarely found except for the mummified fruits. The most important yeasts for cider production are those of the genus *Saccharomyces* and the weakly fermentative *Kloekera apiculata*. The latter rapidly develops, favored by aerobic conditions giving undesirable compounds, but is inhibited by the action of sulfur dioxide and ethyl alcohol over a concentration of 2-5%. When the fruits are ground and pressed the juice acquires an additional microflora whose complexity varies with the degree of cleaning of equipment and premises. It was observed that in the productions of cider with a high degree of hygiene the micro-organic component of the juice includes all kinds indicated with the exception of *Saccharomyces*. This fact is indicative of their position in the plants, in fact, the saccharomycetes develop in the hours after pressing (4).
To this kind belong various species of yeasts that act synergistically: the most specific and the most common in the cider is the *Saccharomyces cerevisiae var. uvaru* in association with *Saccharomyces florentinus* and the Saccharomyces cerevisiae var. *apiculatus*.
Bacteria are necessarily tolerant of acid and alcohol tolerant, this limits them to few genus: *Acetobacter, Gluconobacter, Lactobacillus, Leuconostoc, Pediococcus, Zimomonas,* that they are able to grow at pH values less than 4. The presence of these bacteria on the hanging fruit is very rare or nothing (0-100 cells / g), high is instead that of the inhibited acid bacteria (100'000-500'000 cells/g). The first highlight in the healthy fruits after a few weeks of storage (3000 cells/g); in the damaged fruit their concentration greatly salt (430'000 cells/g). The activity of these bacteria in the last event is highlighted by the smell acetic and by the temperature. The most frequent are the *Gluconobacter oxydans,* the *Acetobacter acetii* and the *Acetobacter xylinum.* The first is particularly important since, being still poor ethyl alcohol, uses the fructose producing an intermediate metabolite that binds the free sulfur dioxide inactivating it. Inhibited by fermentation, acetic bacteria reappear only decreasing the anaerobic of the medium. *The Gluconobacter oxydans* prevails at the beginning of fermentation, then takes over the *Acetobacter acetii* more tolerant to alcohol. The bacillus heterofermentative *Lactobacillus pastorianus* var. *Quinicus*, so named for the characteristic of transforming malic acid into lactic acid and quinic acid in shichimico acid, it is frequently found in the fermenting juice. Another frequent microorganism is coconut heterofermentative *Leuconostoc mesenteroides.* The bacilli homofermentative especially include species *Lactobacillus mali* and *Lactobacillus plantorum*. The genus *Zymomonas* (Gram -) causes the abnormal fermentation of various pentoses and hexoses with accumulation of acetaldehyde.

Materials and containers

The juice having a pH from 3.2 to 4.4 is particularly corrosive and requires equipment and containers that are not impervious and that do not exchange ions. To work the must and cider are very suitable stainless steel, steel coated with epoxy resin, the wood does not resinous, high density polyethylene, nylon and fiberglass. The equipment made of zinc or cadmium have to be avoided as their soluble salts they are harmful to human health. The same applies to the materials manufactured in copper and in non-stainless steel although less toxic. Some metals catalyze browning of apple cider in the presence of air and characterize it with a disagreeable taste metallic. In the sixties, the tanks were used in cement coated bituminous material, epoxy resin or glass tiles but were overcome because of the moisture-related drawbacks which passed through the walls and to corrosive solvents used for the cleaning. Also the aluminum used, anyhow it was slowly eroded even if did not confer defects in cider. To contain cider or fermenting must are used fiberglass tanks or stainless steel, the wooden barrels, and in the handicraft, the carboys. The latter are characterized by some drawbacks constituted by the passage of light and the closure that is to be rendered airtight by equipping the stopper of an air-lock during fermentation and a filling cap in the subsequent processing stages. The tanks in fiberglass and stainless steel are widespread in plants of a certain size. Stainless steel is however the best material because it does not alter the cider nor is affected by it, is a very good conductor of temperature and is easy to wash. The tubs are similar to those used for oenological use, but not all of those made of fiberglass are suitable to cider although produced for food uses: easily are vessels designed to contain milk, syrups or essences which have a virtually neutral pH values. The wooden casks not resinous (chestnut or oak) have been used for centuries by the producers and still are in use in many wineries producing ciders of Brittany and Normandy more for binding to an image and tradition that for a real value quality of the material. The disadvantages of wood are numerous: Soak, retains the residues of fermentation facilitating the onset of mold, it increases the risks of acidification and requires accurate hygiene. The barrels, once filled, are subject to lapses in content due to the absorption of the wood and therefore need to be addressed constantly otherwise the sour cider with speed through the wide contact surface with the air.

Stages of production

Production phases are divided into:	- selection and washing of apples
	- juice extraction and possible concentration
	- clarification
	- fermentation
	- preservation treatments
	- packaging

Selection and washing

The selection is important for two purposes:	use fruits with a better plant health and the right degree of ripeness
	mixing the appropriate amounts of different varieties of apples to create a beverage with the desired characteristics

This last point highlights how cider is characterized by a territorial product type where the mixing of apples is made according to the tastes of consumers, according to tradition. For example the French cider suffers organoleptically habit to wine of the population and is then changed in several ways: acidification with ascorbic acid, addition of glucose syrup, sparkling wine in the bottle with liqueur de expedition. UK cider contends consumers to beer and industrial manufacturers try to get a round taste, mellow and sweet, associated with a color similar to that of the red beers. The degree of maturation greatly affects this phase in fact with physiological maturity the amount of juice supplied is maximum, whereas in advanced maturity can also decrease by 20%. So it is important to work immediately apples of early varieties and wait for the right degree of ripeness for the semi-hard or hard apples taking care to place them in a dry, ventilated place. In industrial manufacturing company cider fruits they are stored in silos awaiting processing and subsequently washed. The fruit is initially conveyed into ducts with water equipped with nozzles which invest it with a sodium hypochlorite solution of low concentration to eliminate the traces of soil and plant protection products. These pipelines also have the function of hydraulically transporting the apples towards a screw elevator. The latter has the characteristics of: transporting the fruit to the crusher hopper, rinse the fruit with a countercurrent stream of water, slowly turn to favor the rinse, have a large radius to facilitate the movement of the fruit.

Juice extraction

The cold extraction is performed and is performed in two stages: grinding and pressing. These two operations must be performed very quickly in order to limit the oxidation of the must. Trituration has the aim to break the largest possible number of cell walls of the fruit facilitating the outflow of the juice. This is done with machines that crush or cracking pulp. Exit the material must have a variable particle size consistency of 5 to 15 mm. The adjustment of the size of the particles is correlated to its consistency and quality of apples. Theoretically the yield after pressing is inversely proportional to particle size; but in fact a too pasty and firm texture is hardly pressable because it lacks an adequate draining support. The particle size of the shredded product is also in relation to the content in pectins of the raw material. The cider apple rarely contains high pectic soluble fraction since the high phenolic content limits the action of pectinolytic enzymes. Even in the kitchen apples, the low pH of these enzymes carries the same inhibitory action of tannins. If the fruit is characterized by a high content of pectic there is a tendency to treat the pulp with pectolytic enzymes in advance for pressing. This treatment is also called enzymatic and consists of adding 20 g / hl of enzyme leaving it to act for 20 hours at a temperature of 40 °C.

For shredding present the following machines are used:	**Hammer mill**: the fruit comes from above and a number of pestles hammer-shaped turn and crush him by chopping
	'Porcupine' grater: it is constituted by two cylinders with serrated toothed surface that run at different speeds
	Industrial grater: in the central part it presents the propellers that push the fruit by centrifugal force towards the walls of a cylinder formed by serrated knives
	Stassier shredder: it is formed by a rotating toothed cylinder with deformed holes of 5-8 mm diameter which coincide with the toothings

The machines that compress the fruits have the defect to crush the seeds if they are governed badly, this gives the cider a bitter taste. In traditional industrial processing is left to macerate the pulp for 6-8 hours before the pressing causing oxidation and browning of the polyphenols with the relative insolubility of tannic substances. This improves the clarification. The oxidation of the polyphenols is due to the action of the enzyme oxidase which acts on the phenolic rings giving rise to the formation of hydrogen peroxide.

type of treatment	juice yield	characteristics of the juice
rapid pressing	40 %	turbid
very slow pressing	80 %	clear
enzymatic and rapid pressing	75 %	40% clear, 35% turbid

The industrial pressing is made by means of pack vertical presses ("rack and cloth" or "pack presses") the hydraulic version mono-plate or in the tri-plate version. With these machines you operate at pressures ranging from 10 to 25 atm. The pulp is placed on racks or frames stacked in layers with a thickness of 5 cm separated by canvas and is pressed repeatedly. The pack presses give a yield in the work of 1000-3000 kg / hour and a yield of 75% juice. Currently this type of machinery is disused in large industries because of the high labor that requires. There are automated versions of the pack presses called "continupack" but they have not been very successful due to the high installation cost and incomplete autonomy. *Among the presses currently on the market a widely used model in small companies is the "Softpress" of ATI international company.* This press while being discontinuous is automatic and is constituted by a membrane of elastic material placed centrally in a fully pierced tank. This mass press the membrane against the metal wall of the tank for the entire 360° surface realizing a thin layer of apples allowing a very fast drainage of liquid. The resulting juice is oxidized but fairly clear, the working times are fast compared with the times of vertical presses; the yields are satisfactory: 70-78% in juice and 8-10 t / h in work, in function of the tank capacity of the press. There are also other discontinuous systems, with a horizontal axis and also in hydraulic pneumatic version; yields and times are similar, but the juice is more turbid. In the United States between the semi-continuous systems horizontal presses two worms coaxial and counter-rotating "Speichim" are used, these give high yields, but the juice is loaded with suspended solids and requires one or more filtering. To facilitate drainage in these presses, US producers use to add to the puree the rice husk and cellulose that keep even clean sieves. *Also the ATI international company has in its catalog a suitable twin-screw press to the pressing of apples at the same level as those in use in the United States.* The belt presses are the most recent and give yields in must lower the machine with elastic membrane but they can work more easily apples soft and spongy texture; They are used coupled to speakers in against stream of cold water. Sometimes in industrial processing pulps are used for two extractions: the first to get the pure juice or "pur jus" and the second to extract the 'sidretto' or "petit jus" soaking the crushed product with 1/3 or 2/3 of the water. After a few hours from the saturation of the mass will have a new pressing and the exhausted pulp is then treated in an extractor with cold water which is enriched with soluble substances (sugars, acids, polyphenols, flavors, etc.). The liquid obtained, said diffusion juice, will serve to cut to 13-20% pure juice to obtain a must with a density of not less than 1051-1059 and with 90 g / l of sugar, which corresponds to an alcohol content of 5% potential. In Normandy and Brittany the 'sidretto' is fermented and distilled to obtain the "calvados". After the pressing, the juice is filtered through a static filter or with a vibrating screen and the particles collected are added to the pulp to be pressed. The contact with oxygen should be limited, it causes the enzymatic browning of the polyphenols and to prevent the "oxidasic casse" in the bottle. However, it was found that the juice undergoes a limited oxidation of hours takes on a more harmonious taste and lose color greenish; also the risk of browning in the subsequent processing steps is significantly decreased due to the deposition of the most sensitive polyphenolic substances. To get around this problem created by the strong alternation tendency of cider apple orchards, the industries of a certain size concentrate storing cider long due to the high osmotic pressure. This procedure allows to regularize the annual output and to make prices stable. The use of concentrates, routinely practiced by British companies, was also recently allowed in France. The most serious problem of the concentrates is the substantial loss of aroma during the concentration step, therefore, before executing it, it heats the juice to 95 °C with 1 atm pressure. removing 10-15% of water and by stripping the aromas in an expansion chamber. The aromatic substances are then reintroduced into the juice. Sometimes you can use carbon dioxide as a selective solvent for flavorings. The heat treatment strongly inhibits the pectolytic enzymes and then the juice, after the concentration, would be in form of gel lumps within the container. To overcome this problem, selected enzymes consisting of polygalacturonase and pectin are added to the not yet concentrated juice, these are left to act for 1 to 2 hours at a temperature of 40 ° C; this allows enzymatic hydrolysis of the pectic fraction soluble into mono and digalatturonico acid units. During the process, also a sizing with gelatin and calcium chloride is carried out to improve the clarification and flocculation. The solids are separated using sieves with vertical filters, rotating filters or siphoning the juice. The concentration is done under partial vacuum at 80 mmHg and at 45 ° C up to a final volume of six or seven times less and a minimum soluble solids content of 70% (w / v). The freeze-concentration and reverse osmosis offer considerable advantages in alternative to the method above. After a flash-pasteurization of 110 ° C for 15 seconds, the concentrate is kept in refrigerated containers under carbon dioxide pressure of 3 Kg/cm^2. The only problem of the concentrates is constituted by molds and osmophilic yeasts that may develop over the thin film of moisture condensed format dilution on the upper wall of the container. The concentrate, diluted with the appropriate amount of water, and the fresh juice are treated with sulfur dioxide or metabisulphite adequately their pH value and the concentration of pyruvic acid, acetaldehyde, ketone and aldehyde groups which bind to this preservative.

Clarification of musts

In this prefermentative working phase the must is clarified to decrease the turbidity and the viscosity of pectin and nitrogenous substances. The drastic reduction of the latter is important for the control of development of fermenting yeast and to obtain a slow fermentation with production of a more complete and harmonious bouquet. The low nitrogen content also improves the stability of the product during storage by lowering the risk of incurring a malolactic deacidification.

There are various methods of clarification	- by means of calcium pectate formation
	- for depectinization and bonding with jelly
	- floatation
	- ultrafiltration

The defecation **by means of calcium pectate formation** is a natural process based on the static clarification of the must and is performed by many French companies to get a higher quality cider through the natural fermentation of the block. The process consists in the de-esterification and hydrolysis of pectins by pectolytic enzymes naturally present in the juice with formation of pectinico acid chains which is insolubilized in salt. In this salification the calcium form of the calcium pectinato which gels and flocculates in the surface two or five days later. Its action is comparable to that of a filter which, rising, brings with it many suspended particles, forming a compact and thin crust of brown color called hat or "chapeau brun" on the surface. The must is at this point clear and travasabile. The clot floats thanks to the formation of carbon dioxide during the fermentation phase and retains not only the particles in suspension but also part of micro-organisms and of the nitrogenous substances lengthening the fermentation period. The derivative cider will be more aromatic, stable and with a mean value of reducing sugars. Thanks to the use pectolytic enzyme pectin to calcium chloride and the clarification can be controlled with precision, which in nature is impossible. The time required for gelation is inversely proportional to the amount of added pectin and calcium chloride but the shrinkage in the surface of the gel requires the same time. The optimum temperature for this operation is 11 °C.

Compound	**Percentage decrease in the must**
pectins	85 - 95 %
nitrogenous substances	57 %
microbial population	50 - 90 %

The apiculate yeasts, especially *Kloeckera apiculata*, have a more late development in the treated wort while the oxidative yeast *Candida pulckerrima* and elliptic yeasts *Saccharomyces spp*. They are much more abundant than in the must untreated. This report explains the evolution of microflora particular flavor development and superior organoleptic defecated of musts. The ciders produced with this technique are particularly popular and well-known while presenting of the higher purchasing costs. The main problems of this type of clarification are: the overall dimensions of the containers, the extended contact times and the impossibility of predicting the cider density at the end of fermentation.

The depectinization and bonding are the most common industrially clarifications and consist in the initial hydrolysis of pectin with purified pectin followed by bonding with 5-20 g / hl of gelatine or albumin in blood. Gelatin, having positive charge, binds with tannins, polyphenols and suspended solids of negative charge making them fall. It ends with a filtration diatomaceous earth which is as easy as managed clarification. This must necessarily be completed before fermentation then advance use of bentonite or silica gel is unnecessary.

Flotation is the only clarification that can be implemented continuously. It exploits the different densities of the liquid and solid particles to be separated but, while in the sedimentation latter have higher density, in this case exhibit specific weight lower than that of the liquid in which they are dispersed. Therefore, by blowing the inert gas into the suspension, the solid goes back upwards. The main phase of the trial is the change in the "flotation cell" where they are injected simultaneously clear juice pressurized with nitrogen at 4.5 atm. and turbid juice containing previous floccules due to the action of pectinesterase. These desaturate and the gas microbubbles adhere to the surface of the hydrophobic floccules forming the gas-solid aggregates which date back in the form of lees evacuated continuously. The clear juice is continuously recovered. There are devices built for this by some Canadian researchers and is marketed under the term "Clarifruit". They have the characteristic of having a flow rate of 100 hl / hour input. The juice must make five passes through the cell before exiting the system. The yield in clear juice is especially high (92%) while the lees (8%) are conveyed to a rotary vacuum filter that retrieves another juice for a total high yield (98%). *The firm ATI international manufactures flotation machines able to work from 50 to over 300hl / hour cloudy must which does not undergo recirculation being pressurized directly entry based on the system (juice clarification system),* invented by a Trentino researcher who is more simple and effective than Clarifruit. The removal of suspended solids is 90% which represents a much better result than those obtainable with other methods. The use of an oxidizing gas (air) as a floating agent, stabilizes the polyphenols in tannin fractions and catetiche which polymerise and separate along the other processing steps. In this process, the optimum amount of fining agent is represented by 9 g / hl of gelatine, 45 g / hl of silica gel, 20 g / hl of bentonite. The depectinization of the juice takes place before the flotation, adding 4 g / hl of enzyme and leaving it to act for 90 seconds at room temperature. The main advantage of flotation is the absence of the use of harmful substances.

Ultrafiltration is inadvisable because of polyphenoloxidase activity caused by a shrink treatment. The juice by this process tends to darken too much and be difficult chiarificabile. It was used until a short time ago to concentrate must intended to cut.

Other pre-fermentation treatments

Generally before fermentation is added to the must 50 mg / l of sulfur dioxide to inhibit the oxidative enzymes and to operate a selection on fermentative microorganisms. The must may be enriched with 30 g / l of concentrate at 70 ° Brix to standardize the potential alcohol in 5.8 to 6% or it can be cut at the end of the fermentation to increase the percentage of sugars. You can also add ammonium salts to encourage the growth of yeasts.

This is a usual practice in Great Britain and Germany in order to conclude quickly fermentation, limiting the risk of occurrence of microbial diseases caused mainly by *anaerobic Zymomonas*. In Germany the addition of ammonium phosphate maximum is 40 g / hl by law. A study conducted in Waadenswil in Switzerland underlined the consumer preference towards the bland cider and harmonious that is produced by the clarification and pasteurization of juice followed by a fermentation with selected yeasts.

Fermentation

The fermentation of cider differ substantially from that of other fermented beverages. It is generally slower and lasts from one to three months as it is conducted at low temperatures of 8-14 °C. With this process there is a strong decrease in the loss of aromas made from carbon dioxide. In addition, the fermentation is partial even if ciders "brut" or dried because it is always a certain amount of residual sugar in the finished product; the actual alcohol content is 5% on average. Nitrogen, present in an amount of 40-300 mg / l, plays an important factor in the fermentation as it is responsible for the slowness and the eventual block. To obtain these results, it is advisable to reduce nitrogen fertilizers in cider apple orchards, reap the fruit at optimum ripeness and clarify the must perfectly. The microflora responsible for the fermentation is very large, complex and spontaneous dominated by *Saccharomyces cerevisiae* var. *uvarum* but there are also other important species of yeast for the aroma development: *Candida* spp., *Debaromyces hansenii*, *Hanseniospora valbyensis*, *Issatchenkia orientalis* (*Candida krusei*), *Metschinikowia pulcherrima*, *Pichia fermentans*, *Pichia membranaefaciens*, *Pichia* spp., *Saccharomyces cerevisiae*, *Saccharomyces klugueri*, *Torulospora delbruckii*, *Williopsis saturnus*, *Yarrowia lipolytica*, ecc. The list is incomplete but there are other important species such as *Zigosaccharomyces rouxii* and the *Brettanomyces clousenii*. The yeasts not only transform the glucose into ethanol and carbon dioxide, but produce a large number of chemicals products that become part of the cider composition such as acids, aldehydes, ketones, esters, lactones, etc. During fermentation, the yeast can produce non-volatile acids such as succinic, malic, citric, lactic and alpha-chetoglutarchico. The quantities of these compounds are influenced by the conditions of fermentation, the pH, the species of yeast, and the amount of nitrogen available to them. From *Saccharomyces fragilis* it was isolated an enzyme common to all other yeasts of the group that has the ability to hydrolyze the pectic acid. Some yeasts have the possibility of producing unwanted substances in substantial amounts such as hydrogen sulphide.

The fermentation can be divided into three basic points:	**prefermentation**, where the fermenting microflora is diverse and complex but limited;
	true fermentation, where there is the almost exclusive action of ***Saccharomyces cerevisiae* var. *uvarum***;
	post-fermentation or maturation, where new secondary yeast species appear

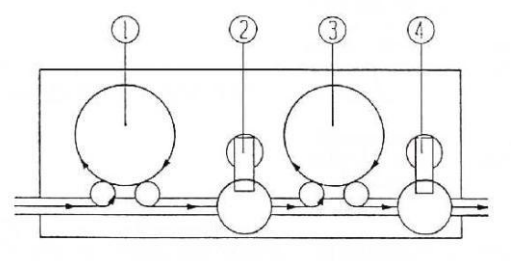
This sequence in the activity of the yeast appears to be essential for the development of compounds with organoleptic characteristics. Studies on the type of consumption have shown that fermentation piloted with the pure strain *Saccharomyces cerevisiae* var. *uvarum*, after prior removal of the natural microflora, it gave products from little vinous taste suited to the traditional cider consumer habits. However there are companies engaged in this type of proceedings; England is the case where we use plentifully sterile concentrated. Even in Germany the addition of selected yeasts is frequent while in Spain and France spontaneous fermentation is the main technique. The speed of this process can be influenced by different strains of *Saccharomyces cerevisiae* during the fermentative process and the intervention of lactic acid bacteria, favored by the temperature close to 15 ° C and from pH greater than 3, which transform sugars into D and L acid - lattico, while at the end of fermentation can cause a biological deacidification where the malic acid is converted into L-lactic acid and carbon dioxide. This transformation is called malolactic degradation. After the first type of bacterial intervention salt the pH of 0.1 - 0.2 causing a variation of the organoleptic quality of the product. At the same time the product is exposed to the attack of other bacterial degradations.

Unlike wine, cider buys from malolactic fermentation a more acidic flavor. This is due to the increase in volatile acidity caused by the activity of heterofermentative bacteria and lack of sugar that attenuate the perception of acid. The wine has a very low malolactic conversion rate, whereas in cider this value is very high and exceeds 0.8. The acetic acid, which in the first case is at most 0.5 g / l, in the second case reaches 1.3 g / l., the dregs of fermentation and the health of the fruit used affect the rapidity of this process that can demolish the acid malic 3-45%. The deacidification is also due to the transformation of malic acid into dicarboxylic acid(7). To prevent malolactic 150 ppm of sulfur dioxide are used, while 100 ppm prevent it initially, but the risk persists during storage. The low pH inhibits it and so did a high percentage of alcohol: at pH 3.2 and 9.4% alcohol with temperatures above 10 ° C malolactic fermentation ends in 63 days while it takes only 13 with a percentage above 3% ethyl. In Norman companies, fermentation takes place outdoors in large 400-750 hl vats or even 2000 hl and is blocked by subjecting the cider to a series of centrifugation, filtration and cold treatments. The value of the density at which the treatments are carried out is of 1,040 for sweets ciders with 50 g / l of sugars and 1.020 for dried. Storage takes place in sterilized kegs or, for industries with spacious cold storage, in refrigerated tanks.

Preservation and packaging treatments

Cider is an extremely favorable substrate for the development of yeast due to its composition and the limited acidity (pH 3.2 - 4.4). All treatments directed first to the must and then to the cider have the effect of unbalancing the microflora to the advantage of some species of bacteria that cause, among other things, the malolactic fermentation. If this transformation of malic acid is favorable or not to the organoleptic qualities of the cider it is an open question, of course it is negative for the next stability. A typical post-malolactic disease is the "cider sickness" or "Framboisé" induces English producers to quickly conclude fermentation with the total consumption of reducing sugars. It is caused by the *Zymomonas anaerobia* bacterium which, while resisting to sulfur dioxide does not tolerate a pH below 3.7. The consumer demands a cider as natural as possible and not pasteurized; with this type of product the most important post-packing problem is the malolactic inside the container. This, while not creating visible physical alterations of the drink alters the sugar / acid ratio; also the heterofermentative lactic bacteria sensitive metabolize amount of acetic acid. The cider intended to be marketed turbid is cut to reach the right density and undergoes a simple centrifugation; a slight addition of sulfur dioxide is occasionally performed as an antioxidant and anti-bacterial. For pasteurisation tunnel pasteurizers are used but it is a rare treat given the strong thermolability components. To obtain a clear and crystalline product, the cider is subjected to finishing with clarification by means of gelatine and blood albumin followed by the natural static decantation. After the removal of the lees from leaking by means of centrifugation, the cider is filtered with diatomaceous earth and can be corrected in the content of carbon dioxide with doses of 3-5 g / l of this gas. This is followed by bottling and packaging of cider. In this phase it is important to maintain a situation of aseptic and anaerobic conditions using sterile materials and machinery that work under inert gas. For ciders of a certain quality cold sterile bottling is used and even low oxidation bottling similar to oenological one.

Generic bottling scheme



1) Rinsing of new bottles with sterile water
2) Deaerating and filling the bottles with inert gas
3) Fill the bottles with cider
4) Corking with cork

Cold sterile bottling cider is filtered with aseptic cartons having very fine mesh (sterilizing filtration). At the same time, the bottles are pretreated with a spray solution of sulfur dioxide at 2% both internally and externally just before being filled. It is advisable to make the treatment of the bottle even if it was purchased with sterility assurance. The spray with sulfur dioxide, which causes the air outlet, is replaced with insufflation of steam or sterile air in order not to further enrich the cider of the compound antiseptic. It follows a sterilizing filtration and bottling.

Recently, mainly two types of sterile bottling are used:

1) washing with sulfur dioxide solution, air pre-evacuation, compensation with nitrogen (inert gas), nitrogen puff after bottling.
2) washing of 15-20 seconds with solution of 1 g / l of sulfur dioxide, moisture evacuation with sterilized air, blaze on the bottle mouth.

When you do not want to deplete the carbon dioxide cider, this inert gas is introduced with the nitrogen in the proportion of 20-80%. For the modest fine ciders are used containers tetra pack type: before packaging the product is subjected to a blancking and often the tetra pack containing cider is pasteurized again.

Legislative aspects

The most recent legislation on alcoholic beverages refers article 23 of D.L. n°331 30/08/1993 and subsequent modifications which do not circumscribe precisely our product. The cider is however, among fermented beverages as defined not dangerous with real alcohol content of between 1.2 and 10%. The UTIF is awaiting implementing regulations of the aforementioned decree recognizing the product permanently. Currently (as of today we are creating the article) even the MAF has yet proposed a mandatory type of registry for cider producers.

Classification

The diversity of origins and the conditioning of cider make a very little standardized product which is located on the market in different forms. For products intended for non-local marketing and the largest distribution network it is imperative that there is an absolute absence of microbial cells; or this reason some industries adopt the membrane filtration. By law in France cider them must have a greater than 5% alcohol content is offered more or less sour, sweet, alcoholic and clear according to the area of origin, consumer tastes and technological level of the cider house.

Standardization in France:	Standardization in England:	Standardization in United States:
1) Cidre doux: It shall provide by law a real alcohol content of less than 3% minimum 50 g/l of residual sugar.	**1) Still and hazy cider:** naturally fermented, traded by large farms.	**1) Still and hazy cider**: naturally fermented, traded by large farms.
2) Cidre demi-sec: It contains 20-g / l sugar. It is pasteurized and clear.	**2) Naturally conditioned cider:** It is sweetened before fermentation that will give the right amount of carbon dioxide in the bottle.	**2) Naturally conditioned cider**: It is sweetened before fermentation that will give the right amount of carbon dioxide in the bottle.
3) Cidre de table: It is obligatorily pasteurized, ordinary bottle, 5-5.2% alcohol and clear	**3) Artificially conditioned cider:** It is (cider) sterilized by sterilizing filtration or flash-pasteurization under pressure at 82 ° C for 15 seconds and packaged with bottler backpressure. Adding sulfur dioxide before bottling to control infections arising from bottles or by the bottling machines.	**3) Artificially conditioned cider:** It is (cider) sterilized by sterilizing filtration or flash-pasteurization under pressure at 82 ° C for 15 seconds and packaged with bottler backpressure. Adding sulfur dioxide before bottling to control infections arising from bottles or by the bottling machines.
4) Prized cider (cidre bouché, bottle Champenois, alcohol 5.6-6 %. **3) Dry cider:** Total residual sugar < 10 g/l. It is centrifuged and unpasteurized	**4) Scrumpy**: fresh cider flavored with honey, is consumed within three months of collection	**4) Scrumpy**: fresh cider flavored with honey, is consumed within three months of collection

		5) Hard cider: it may contain more than 8% of alcohol and can be produced with the Champenois and Charmat methods
		6) Sweet cider: produced by farms with fruit (cider) discarded from the sale, is marketed both by the same company that shops
		7) Canned apple juice: product with the dessert apples excess on the market or due to physical defects. It is sweet and low in alcohol

The major industries that control much of the UK market commercialize mainly four types of cider:

"**Still dry**": non-carbonate and dry;
"**Still sweet**": non-carbonate and sweetened;
"**Sweet cider**": carbonate and sweetened;
"**Dry cider**": carbonate and dry

In Anglo-Saxon countries are more used packaging tetra pack type or "pressure barrels" with the appearance of small barrels with screw fixing and equipped with plug to draw off the liquid from the bottom which makes them very popular for home use.

The current situation

The national market for alcoholic drinks has suffered in recent years a general reduction in per capita consumption. This is probably due to the tendency of the consumer to take drinks with low alcohol content and light taste; It is indicative that the statistics prove the increase in demand of beer and the decrease in sales in the wine industry. The differentiation in the types of beverages consumed was also demonstrated. In the Italian market, characterized by the presence of almost all types of alcoholic products, it astonishes the almost total absence of manufacturing and marketing of apple cider or kind of fruit that is not fermented grapes.

NOTES anyone who reads this article and can provide additional information to improve and correct the text can send an email to our company, we will be happy to cooperate to give the fullest possible information to the information only to those who want to read up on techniques for making cider. The article is published to give general guidance on the types of cider processing, not intended as an application manual, or an example to follow. The good work practices should always be handled by a technical manager and which presents one working standards and is familiar with the current regulations to be implemented for which we assume no responsibility for any use and / or application of the information in the article published by us.

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