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Development of Water Melon (*Citrullus vulgaris* L.) Red Wine

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Abstract

This work aims at developing an alcoholic drink from water melon fruit in order to reabsorb the water melon surpluses and to reduce the pressure made on cereals (sorghum and corn) for the manufacture of artisanal alcoholic drinks. Antioxidant effect of polyphenols, was studied, total polyphenols, ethanol, methanol and total acids content of red water melon wines were determined and compared to a product used in human therapeutic; an extract of the *Ginkgo-biloba*, one local sorghum beer, palm wine and few industrial wines. Results indicate that water melon based alcoholic drinks present an ethyl alcohol content varying from 8±1% to 13±1%, a total acidity from 1.2±0.1g/l to 1.7±0.0g/l. The newly produce water melon based wines present high content of polyphenols, and strong antioxidant capacity compare to the *Ginkgo-biloba*, sorghum beer and the tree other samples wines. A reasonable consumption of 240 ml/day of water melon wines represents a polyphenol contribution of 403 mg/day and an anti capacity oxidizing respectively of 4.25 or 2.4 mmol/day versus 0.18 mmol/day for the *Ginkgo-biloba* extract.

Keywords: alcoholic drink, water melon, polyphenols, antioxydants

Introduction

The introduction of water melon (*Citrullus vulgaris* L.) by research and development in sudano-sahelian zone of Cameroon was a success (Moustier, 1990; Essang, 1994). The plant in addition to its adaptation to the difficult agro ecological conditions of the area is, with the introduction of the 'Sugar Baby' variety, more productive one (Seignobos, 1992; Temple, 1997). It's resistant to *fusarium* and *anthracnose* attacks (Fruitrop, 1990). Indeed, the observed good production yield is link with rapid post harvest deterioration, (Temple, 1997) mostly due to the bad storage conditions as populations cannot consume all the production at the same moment. This work aims at developing a new alcoholic drink from water melon fruit and thus lengthens the shelf life of the fruit.

Material and method

Fruits samples: About 10 freshly harvested fruits of water melon (*Citrullus vulgaris* L.) were purchase from local farmer, clean peeled and store at room temperature 24 hours before the experiments.

Analytical methods

Two water melon wines (Must I and II), local beer sorghum (Bibil), and palm wine, were analyzed and compared to the extract of the *Ginkgo-biloba*.

The pH was determined using a Kent EIL 7020 model pH meter. The pH of the fermented liquor after maturation and control samples was taken in triplicates each.

Residual sugar content analysis was proceded by determination of glucose and fructose using the enzymatic method describe by McCloskey (1978), after maturation.

Titratable acid (as percentage w/w tartaric acid) and different alcohol type and levels were determined according to the Association of Analytical Chemists (1990) methods. Acidity was determined by titration with 0.1N NaOH solution and expressed as percentage tartaric acid. Bromothymol blue were use as an indicator.

The total polyphenols (TP) were evaluated by folin-ciocalteu method (Singleton and Rossi 1965) as follow: Sodium carbonate solution was prepared by dissolving the anhydrous salt (200 g) in boiling water (800 ml). The solution was seeded with a few crystals and filtered the next day. The volume was then adjusted to 1000 ml in a volumetric flask. A calibration set of GA standard solutions (concentration 0-250 mg l^{-1}) were prepared in water. Samples of red wine were diluted 10 fold with water. Each standard or sample (1 ml) was placed in a 100.00 ml flask with water and the mixture was homogenized. After addition of Folin-Ciocalteu reagent the obtained solutions were mixed and diluted to volume with sodium carbonate solution after different periods from 30 s to 8 min. The absorbance was read at 765 nm after storage of the solutions at 20°C for 2 h. The results are expressed in mg/l gallic acid equivalent (by reading at 765 nm). The following Wine were also analyze for comparison purpose: Sorghum beer, Crémant de Bourgogne; Baron de la vale; Palm Wine.

Biomass: Microorganisms as total yeast and mould count were performed by counting after cultivation on Sabouraud media.

Results and discussions

Wine Development

Mellon juice (Must) preparation

Each 500g of clean water melon flesh is grated and mixed with 1 L of clean water. The mixture is then filtered using a 10mm mesh sieve. 20 liters of a clear red juice is extracted. The must is then split in two groups: To the first (Must I) we added 500g of sugar cane and to the second (Must II) we added 100g of sugar cane. Both must are boiled for 15 min. The limpid juice is left to rests and cooled at ambient temperature for 30min. 100 ml of lemon juice and 250 ml of clear orange juice are added and the must are ready.

Starter preparation

The starter culture is prepared by modifying the method describe by Juroszek *et al.* (1987) using 1 g/litre of wine yeast (*Saccharomyces cerevisiae var. bayanus*), which is made into slurry with some of the aliquots to be fermented and mixed into the main portion to which sugar at 23°C Brix is added as recommended by Guymon and Ough (1972).

Mellon Wine Preparation

Previously prepared melon juice (Must) is mix with cane sugar bought from local market to bring the brix value up to 23° brix. The fermenting vessel is filled to about three-quarter full, plug with cotton wool with cork through which the fermenting lock is inserted. Then 450 ppm of Sodium metabisulphite, 0.67 per cent ammonium sulfate and 1 g/litre of citric acid are added to the must. Fermentation is allowed to proceed at a fixed temperature of 25°C in a 7 liter biofermenter (Lafite-France) to avoid temperature fluctuation. The temperature is set at 25°C; pH was stabilize at 5 and dissolve oxygen at 0,5 mg/l for the first 2 hours of fermentation then 0.025mg/l for the remaining time. The unit is left ferment during 5 to 6 days. The fermentation is stopped by cooling the Wine at 4°C for 48 hours.

Maturation of wine

The fermented liquor is filter, and rack into a clean wood based container fill up to the neck and lightly covered with cotton wool. This is then allow to age for about 28 weeks during which racking is done at 8 weeks intervals at a temperature of 28°C. After storage, physicochemical parameters are carried out in triplicates and mean values are recorded.

Chemical composition of Melon red Wine

Polyphenols content and total antioxydant status

The chemical composition of melon Wine summarized in Tab. 1 indicates that the red wines containing water melon pulp are rich in polyphenols, and present drinks of the strongest antioxydant capacity. With equal volume (liter), the other wines, analyzed in this work have an antioxydant capacity two to three times less than *Ginkgo-biloba* extract and Palm wine and is lightly less than Baron de la Vale. It has to be mentioned that the usual amount of *Ginkgo-biloba* used in human therapeutic (disorders of the senescence) is 3 to 6 ml /day (Collado and Serrano 2010; Vidal, 1998, David, 1995). We can thus conclude that a contribution of 60.54 mg/day and an antioxydant capacity of 0.18 mmol/day can be provided by the melon Wine. A reasonable consumption of 24 cl/day of traditional beer (bilbil) and Palm wine represents a polyphenol contribution respectively of 804 mg/day and 403 mg/day and an antioxydant capacity respectively of 4.25 mmol/day or 2.4 mmol/day versus 0.18mmol/day for *Ginko biloba* extract.

We observed a positive correlation (coefficient of correlation Pierson) between the polyphenol rate and the TAS: r=0.89 for Must 1, r= 0.86 for sorghum beer (Bilbil) and r= 0.87 for the whole of the studied products. The results concerning wines are comparable with those observed by Cusker and Frizgerald, (1995). To these amounts and according to proportion, the wine consumption presenting these characteristics showed an antioxydant potential higher than that observed by administration of *Ginkgo-biloba* a product used for therapeutic purpose in human senescence disorders (Shi *et al.,* 2010). Theses result can be interpreted according to some authors observing that the incidence of insanity is less in a population which drinks 250 to 500 ml of wine per day (Orgogozzo, 1997; Renaud and Lorgeril, 1992; David, 1995; David and Martin, 1998, Martin, 1998)

Tab. 1. Polyphenols content and Total antioxydant status (TAS) of the analyzed drink samples

Product	Total Polyphenols mg/l of gallic acid, 765 nm	TAS mmol/l, 600 nm
Water melon Wine (Must 1)	3350±122	17.70±1.3
Water melon Wine (Must 2)	1680±101	11±1.2
Palm wine	2700±103	13.5±1.0
Sorghum opaque beer (Bibil)	640±121	0.2±0.0
Ginkgo-biloba	1090±132	36,50±1.7
Crémant de Bourgogne	540±23	0.6±0.0
Baron de la Vale	4045±122	26.5±1.4

TAS°=Total Antioxydant Status

Ethanol and biomass

Ethanol normally accounts for 7% to 16% of the total volume of wine (Vilanova *et al.,* 2007). We can notice here that analysed melon wines samples seems presenting an ethyl alcohol strength more important than beer and other wines samples (Tab. 2). This could be explained as well by the type of carbohydrate source, which is starch for sorghum beer whereas wines contain simple sugars and fast fermentable sugars. The fermenting agent is *Saccharomyces cerevisiae* for wines (except palm wine) whereas the traditional beer would come from a wild fermentation.

Indeed, David and Martin, (1998) indicate that the most influential factors for ethanol production is the starter culture used and the source of carbohydrate. It should in addition be mentioned that ethanol can influence alcoholic drinks in several ways: the quality of the wine, its conservation, its commercial value. Particular attention may thus be given to the ethanol content in the case of possible semi industrial and industrial productions of this developed water melon wine. It may moreover be notice that more a wine is vinous, rich in alcohol, more it is vigorous, rich in extract, and consequently present a nutritional interest. In addition, the proportion of alcohol would be a direct function of the state of maturity of the grape, more the bay is ripe, more it contains sugars (Petzy, 2003). This could also be the case for the use of the water melon pulp and explain the difference in alcohol level observed for the palm wine (which would contain less fermentable sugars). Thus alcoholic strength of the natural wines, i.e. wines without alcohol additives, rarely reached 16%. Indeed, yeasts hardly support high alcoholic strengths produced during fermentation and stop working imperceptibly. This is observed by the weak rates of biomasses obtained for high ethanol contents (Tab. 2).

Methanol

There's always a small amount of methanol in wines. This amount varies from 36 to 350 mg/l (Konneh and Caen, 1998). The high methanol content observed in the case of sorghum beer come from the hydrolysis of sorghum pectins during fermentation (Bernhard and Zeiku 1980). Pure alcohol fermentation of saccharose produces only traces of methanol (Dietmar, 2006). Pure pectin being consisted of a chain of galacturonic acid (called "pectic acid") esterified by carbinol; the fermentation of sorghum must, could be accompanied by hydrolysis of insoluble pectic acid. For this reason, methanol rate could be function of the importance of the maceration of the solid parts of the vintage, in particular of the films, in must. This is consolidated by the observations of Konneh and Caen, (1998) which indicate that the red wines, with 152 mg/l of average, are richer than the rosy wines (91 mg/l) and especially than white wines (63 mg/l).

Acidity

It is noticed that water melon wine is in overall less acid than others (Tab. 2). This is very interesting for gustative point of view. However considering microbiological and hygienic parameters, this will be a disadvantage. In fact wine contains a quite good amount of mineral and organic acids (Selli *et al.,* 2004). Some acids of the wine are entirely combined with bases; they are at the salt state and consequently do not intervene in acidity. But the organic substances, and particularly acids, are partially saturated by bases. Some of their molecules are at the salt state, others are free. The sum of free acid functions and partly free acids, constitute the acidity of the wine. In addition, the free acid functions are partially dissociated or ionized and release in the liquid as hydrogen ions which represent the "real" acidity, whose concentration is expressed in pH in wine, the proportion of ionized acid compared to the total number of free acid is about 1%. In other words only a small amount of wine free acids are ionized. Thus, they are relatively weak acids. The acetic acid which generally appears at the beginning of fermentation; generally pass by a maximum when half of sugar is fermented: the content decreases at the end of the phenomenon.

The content formed by yeasts varies according to conditions of fermentation, according to the composition of must, the species and the stock of yeasts, but it remains weak in practice. Normally, bacteria involve in malolactic fermentation in parallel form a small proportion of volatile acidity (Beelman and Kunkee, 1985). It comes especially from the decomposition of the citric acid, which is done at the same time as that of the malic acid, but also possibly of the lactic fermentation of small quantities of sugar, from pentose in particular (Davis *et al.,*1986). Volatile acidities from 0.30g to 0.40 g can be present in wine and is inevitable in the final maturated wines (Henick-Kling, 1995). This does not necessarily mean that they indicate at the beginning of deterioration. Above these values, we can suspect the involvement of pathogenic bacteria and the total destruction of wines: reducing sugars, glycerol, tartaric acid, or the development of acetic bacteria or acetobacters able to oxidize alcohol. The first are optionally anaerobic and multiply in the mass of the wine and form the lactic acid. On the surface of wines maintained in contact with

Tab. 2. Alcoholic content of analyzed drink samples

Product	Ethyl Alcohol	Methyl Alcohol	Number of Microorganisms at the end of fermentation (cell/ml)	Total Titrable acid
Water melon Wine (Must 1)	13%± 1 (102.7±0.4g/l)	0.5±0.0 mg/l	(17± 2).103	3.0±0.0
Water melon Wine (Must 2)	8±0% (63±2g/l)	1.0±0.0 mg/l	(11±2).106	4.2±0.5
Palm wine	10±1% (79±0.0g/l)	79±2 mb/l	ND	2.5±0.7
Sorghum opaque beer (Bilbil)	4±0% (31.6±0.7g/l)	300±11 mg/l	ND	2.8±0.3

ND: Not determined

air, acetic bacteria can develop and oxidized by a breathing phenomenon important proportion of alcohol into acetic acid. Thus, the volatile acidity of a wine gives information on its health, on the gravity of undergone deteriorations. Volatile acidity indicates the past of the wine; it is the mark left by a disease.

Conclusions

In a characteristic context of full blooming of wine industries from tropical fruits, the production of water melon wine could present a double impact. From the economic point of view the development of small local industries of production by groups of women could be an alternative source of income and at the same time the quantities of cereals used for production of local alcoholic drinks, can be safeguarded. On the nutritional level, complementary studies are necessary to better understand the molecules implied in the antioxydant effect of these wines on the one hand, and on the other hand, their relationships to the epidemiologic and pathological observations relating to the cardiovascular diseases, and cancers in the area.

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