The supply side of alcoholic and non-alcoholic beverages with potentially particular appeal to minors. Health effects, market share and possible regulations.

1. Introduction

The aim of this paper is to offer an overview of the supply side of alcoholic and non-alcoholic beverages with potentially particular appeal to minors. The paper deals mainly with both energy drinks and alcopops.

Given the rapidly growing market and the popularity among young people, the paper, at first, offers a description of these products and their ingredients, and the potential health consequences related to their consumption mainly for minors and young adults (Section 2). Section 3 describes the current regulations of these products applied by Member States. The final section concludes.

2. Energy drinks and alcopops

2.1. The new category of alcohol products

The sector of alcoholic drinks has been commonly represented by three main categories: beer, wine and spirits. Certainly, this classification represents a simplification of the products available in Europe. As a matter of fact, a new category of drinks has been introduced in the market, with a particular appeal to minors and young adults (Hughes et al., 1997; Jackson et al., 2000; Mosher and Johnsson, 2005; Anderson and Baumberg, 2006; European Alcohol Policy Alliance, 2008; van den Broeck and de Bruijn, 2010).

As reported by Anderson and Baumberg (2006), the origins of this recent product group can be traced back to designer drinks, mainly characterized by brightly coloured and innovative packaging. During the mid Nineties a new group of brightly-coloured soft drinks, that are part alcohol combined with a sweet non-alcoholic drink, appeared. This new kind of drinks, known as alcopops, was then replaced by both pre-mix cocktails, made by a mixture of spirits, soft drinks and flavours, and a trend towards combining spirits (such as vodka) with high energy soft drinks (such as Red Bull). As a result of this trend, ready-to-drink alcoholic energy drinks have been introduced. These products enclose a combination of vodka, caffeine, glucose and taurine and have been marketed for their supposed energetic properties. Finally, shot drinks represented by strong spirits have risen in popularity among young drinkers (Hastings et al., 2005). Despite these recent developments of new products, beer and spirits are still the most popular drinks for young people overall (IAS Factsheet, 2007).

For the sake of simplicity, this paper refers to alcopops to indicate all of these new products, especially designed and marketed for adolescents and young adults (see for instance: Hughes et al., 1997; Metzner and Kraus, 2008). The reasons that lead many young people to choose alcopops are embodied in their main features: the taste and the flavour, the trendy design, the marketing strategies and the image (a literature review on alcopops is given by Metzner and Kraus, 2008). The sweet flavour, particularly appreciated by girls, masks the alcoholic content of alcopops. For this reason, young people find them innocuous and easily

drinkable (McKibben, 1996; Glenewinkel et al., 1998; MacCall, 1998; Robledo de Dios, 1998; Romanus, 2000; Leeming et al., 2002; Lanier et al., 2005; Van den Bulck et al., 2006). Concerning their design, alcopops are modelled on non-alcoholic drinks, they are trendily and artificially coloured, in small and manageable bottles (Glenewinkel et al., 1998; Robledo de Dios, 1998; Forsyth, 2001; IAS Factsheet, 2007). Additionally, advertisement and marketing strategies targeted mainly at young people (Glenewinkel et al., 1998; Robledo de Dios, 1998; Settertobulte and Hurrelmann, 2003; van den Broeck and de Bruijn, 2010). The association established within advertising between alcohol use, amusement and social approval is particularly powerful (Wyllie et al., 1998). Furthermore, alcopops are associated with an image of youthfulness (Leeming et al., 2002) and their relatively higher price compared to other drinks, also is perceived as representative of an exclusive status (Brain et al., 2000).

The literature identifies that such new products preferred by young people can introduce even younger people to alcohol consumption and, to a certain degree, to other source of drugs (Jackson et al., 2000).

2.2. Representative features of energy drinks

There is no recognised definition of energy drinks. This category of products consists of beverages that contain, beyond natural products such as guarana, ginseng and taurine, modest to relatively high levels and concentrations of caffeine, ranging from 50 to 500 mg or more per can (Reissig et al., 2009; Arria and O'Brien, 2011).[1]

A major challenge for researchers is given by the heterogeneity of the numerous energy drink products available. Regulation of these products, including content labelling and health warnings, differs across countries. The aggressive marketing of energy drinks primarily targets toward children and adolescents promoting virtuous effects, such as improved energy, weight loss, athletic performance and concentration (Heneman and Zidenberg-Cherr, 2007; Babu et al., 2008; Reissig et al., 2009; The European Commission on Food Safety, 1999; Higgins, 2010).

Even though some health benefits may be associated with guarana, taurine and ginseng, there is insufficient quantity of these ingredients included in common energy drinks to deliver either therapeutic benefits or adverse consequences. On the other side, the quantities of caffeine and sugar included in energy drinks may cause serious health consequences, particularly to children and other vulnerable people (Heneman and Zidenberg-Cherr, 2007; Clauson et al., 2008; Seifert et al., 2011).

Another concern is the raising trend of combining caffeine and alcohol. Several studies suggest that such practice may increase the rate of alcohol related injury and may lead to other forms of drug dependence (Collins et al., 1997; Pallanti et al., 2006; Reissig et al., 2009; Higgins, 2010).

Although the trend toward increasing adolescent energy drinks consumption has been identified, research into their use and effects has been sparse (Babu et al., 2008; Clauson et al., 2008; Reissig et al., 2009; Seifert et al., 2011).

[1] For comparison purpose, the caffeine content of a 6 ounce cup of brewed coffee varies from 77 to 150 mg (Griffiths et al., 2003).

The following paragraphs aim to identify the common components of energy drinks and, then, to discuss the health effects given by the consumption of caffeine and the mixture with alcohol mainly by children and young adults. Table 1 synthesizes both the proposed therapeutic benefits and the adverse health effects of those ingredients. Table 2 reports the composition of selected energy drinks.

2.3. Overview of the ingredients of energy drinks

Energy drinks may contain several ingredients, such as: ginseng, taurine, L-carnitine, guarana, caffeine, sugars, sweeteners and herbal supplements. This paragraph describes the main components of energy drinks in detail.

2.3.1. Caffeine

Caffeine represents the principal ingredient in most energy drinks and has been recognized as the most commonly used psychoactive substance worldwide. As a matter of fact, caffeine is present in a wide variety of beverages and pharmaceuticals; it is legally accessible to children and is sold among food and beverage products (Gilbert et al., 1976; Dlugosz and Bracken, 1992).

This ingredient has several physiologic effects, which include elevated blood pressure and stimulation of the central nervous system, skeletal muscles and heart. Furthermore, caffeine is promoted in combination with sports activities and athletic improvement as a diuretic, with the raised risk for dehydration caused by high loss of liquids (Stookey, 1999).

In susceptible individuals, such as children, even small doses of caffeine - from 250 to 300 mg - is also associated to adverse effects, such as nervousness, restlessness, insomnia, tremors, anxiety gastric irritation, nausea and vomiting among the others (Orbeta et al., 2006). Large doses of caffeine are linked to metabolic acidosis, hyperglycemia, tachycardia and ketosis (Clauson et al., 2008). Finally, caffeine overdose can eventually occur at doses of 10 to 14 g (150–200 mg/kg) (Holmgren et al., 2004).

Among adults, high caffeine intake by pregnant women is associated with risk for late miscarriages, stillbirths and small-for gestational-age infants (Greenwood et al., 2010). On the other hand, long-term caffeine use is connected with a lower risk of Parkinson disease and a slower age-related cognitive decline (Rogers, 2007; Seifert et al., 2011).

The common concentration of caffeine included in energy drinks is roughly 75 or 80 mg in a can of 8-ounce; some products have an higher concentration up to 300 mg for a can of the same size. Even though a daily intake of caffeine of 300 mg or less is not harmful for the majority of people, this quantity already exceeds the level at which adverse effects begin to manifest (Clauson et al., 2008). Nevertheless, child and adolescent caffeine intake should not exceed 2.5 mg/kg and 100 mg/day per day respectively (Babu et al., 2008; Seifert et al., 2011). The effects of caffeine in children remains less clear compared to those in adults (Babu et al., 2008; Seifert et al., 2011).

2.3.2. Guarana

Guarana, also identified as Brazilian cocoa or zoom, is contained in the seeds of a South American plant, Paullinia cupana, celebrated for its stimulant properties. The active ingredient[2] in guarana is represented by caffeine, in concentrations of 3.6% to 5.8%. Caffeine concentration may vary extensively in guarana preparations; however, 3 to 5 g of guarana supplies about 250 mg of caffeine (Babu et al., 2008; Clauson et al., 2008).

Given its composition, guarana is used with the same purpose of caffeine. In other words, it is taken to increase alertness and physical performance, mainly through the effects of caffeine. Consequently, the effects of guarana ingestion are comparable to caffeine as insomnia, nervousness, tachycardia among the others. The inclusion of saponins and tannins, however, increases the duration of action with guarana (Babu et al., 2008).

In addition to guarana, several energy drinks contain other caffeine-based herbal ingredients, such as yerba mate, tea, kola nut and cocoa. Inclusion of such ingredients does not require caffeine labelling, with consequent exclusion in calculations of caffeine content (Haskell et al., 2007).

2.3.3. Ginseng

Ginseng is a herbal supplements known commonly worldwide for centuries. There are several varieties of ginseng, but the most frequently considered is *Panax ginseng*, also known as Korean or Asian ginseng (Clauson et al., 2008).

Ginseng is used to improve physical and athletic stamina, enhance overall well-being and enhance resistance to environmental stress. However, the commonest therapeutic use of ginseng is improving cognitive function, concentration and memory (Coon and Ernst, 2002).

The use of ginseng is associated with negative effects, principally insomnia but also diarrheal, hypertension, rashes, irritability and severe headache. Furthermore, ginseng is potentially correlated with estrogen-like effects, breast tenderness or enlargement, loss of menstrual periods and vaginal bleeding after menopause in females. Finally, there is one case describing a patient who developed Stevens-Johnson syndrome, but the causality was not definitive (Dega et al., 1996).

Therapeutic doses for ginseng commonly range between 100 and 200 mg/day. However, the majority of energy drinks contain sub-therapeutic quantities of ginseng, mainly between 25 and 90 mg. In order to obtain the lowest therapeutic dose, a consumer would have to drink at least two to four cans daily. Ginseng has been included into several energy drinks, even though little medical literature supports it use and evidence have not shown significant benefits in enhancing physical performance (Babu et al., 2008; Clauson et al., 2008; Reissig et al., 2009). Furthermore, the effects of ginseng in children and adolescents are still not well identified (Braganza et al., 2007).

2.3.4. Taurine

[2] Active ingredients are components in a drug that provide some pharmaceutical value, in contrast with the inactive ingredients, which act as carriers to make the drug easier for the body to process.

Taurine, or *betaamino acid taurine*, is produced by the metabolism of methionine and cysteine and represents the most plentiful amino acid in animal tissue. It is important in several metabolic processes, such as osmoregulation, antioxidation and glycolysis (Seidl et al., 2000; Brosnan et al., 2006).

Taurine represents an essential nutrient and it is found in meat, dairy products and fish. A standard diet supplies 20 to 200 mg of taurine every day (Stapleton et al., 1997). Furthermore, taurine has been considered necessary during neonatal development and included in infant formula, albeit this practice has never been rigorously studied. In other words, healthy adults can produce taurine from other amino acids, while infants and vulnerable adults must achieve it via foods or supplements (Hendler and Rorvik, 2001; Heird, 2004)

As a dietary supplement, taurine is promoted as improving biliary and eye health, to lower blood pressure and improve cardiac contractility, to lower risk of diabetes and epilepsy. Several studies attempt to examine the positive effects of energy drinks containing taurine, but whether the effects resulted from the individual taurine or caffeine components could not be established (Seidl et al., 2000; Warburton et al., 2001; Clauson et al., 2008; ADCAPS, 2010).

Some adverse effects are attributed to taurine intake, even in relatively high doses. In some cases, energy drinks enclosing taurine and caffeine have been correlated with athlete deaths in Europe, and several countries have forbidden or limited their sales (Nordqvist, 2004). Concerning the effects of high-dose or long-term taurine intake in children and adolescents little is known (Babu et al., 2008).

2.3.5. L-Carnitine

Carnitine is an amino acid derivative and is produced principally by the liver and kidneys. It has a crucial function in the β-oxidation of fatty acids increasing metabolism. Significant quantities of carnitine have been found in the regular diet, but both congenital and acquired deficiency states exist, which are often characterized by profound muscle weakness (Lheureux et al., 2005; Babu et al., 2008).

The evidence concerning carnitine is mixed: some studies reveal positive effects of carnitine supplementation in training and recovery from demanding exercise (Karlic and Lohninger, 2004); other studies found no significant benefits during athletic exercises (Brass, 2000; Babu et al., 2008). Anyhow, no improvement seems to exist in giving an oral dose greater than 2 g at once, since absorption studies indicate saturation at this amount (Bain et al., 2006).

Undesirable effects found in carnitine supplementation comprise nausea, vomiting, abdominal pain and diarrheal. Furthermore, an increase in seizure occurrence has been described with carnitine use in patients with a known seizure disorder; de novo seizures have been stated with carnitine supplementation (Russell, 2007).

2.3.6. Glucose

Glucose is a foremost source of energy for the brain, muscles and other cells of the body; moreover, it is necessary for the normal functioning of the central nervous system and the entire human body. Nevertheless,

only rather little glucose can be accumulated and the body relies on a constant supply of glucose as its principal fuel delivered via the bloodstream.

Excluding sugar-free versions, all types of energy drinks contain sugars (roughly 30 grams/8 ounces) in the form of sucrose, glucose and/or high-fructose corn syrup (Clauson et al., 2008).

Several studies confirm that glucose alone can improve memory, concentration and energy; however, its effect in energy drinks may be synergistic with caffeine. In other words, the addition of a modest amount of caffeine to the glucose component is shown to enhance cognitive performance (Scholey and Kennedy, 2004). A study states that glucose and caffeine jointly can improve behavioural performance during difficult tasks requiring selective attention (Rao et al., 2006). On the contrary, one study establishes that neither caffeine nor glucose independently results in significant enhancement of cognitive or mood (Clauson et al., 2008).

Concerning alcoholic drinks, it is worth a mention that very frequently sugars - including glucose, fructose and sucrose - are added to alcoholic beverages. Most studies on this topic find that sugars decrease the absorption and increase the metabolism of alcohol (Goldberg et al., 1979). Conversely, sweet taste stimulates a reward response in the brain. Hence, adding sweeteners to alcohol products leads to brain reward stimulation (Opperhuizen, 2010). Given that adolescents are attracted towards sweet food and drinks, most probably because of this sweet stimulus reward, sugars increase the attractiveness of alcoholic drinks, principally for novice drinkers, as they mask the bitter taste of alcohol and suppress the aversion towards the taste of alcohol (Nicklaus et al., 2005). Non-sweetened drinks with the same alcohol percentage are consumed less. As a consequence, added sugar likely increases the consumption of alcoholic drinks in young people (Opperhuizen, 2010; Opperhuizen et al., 2010).

2.4. Evidence on the health effects of energy drinks consumption and alcohol intoxication

The recent increase in energy drinks consumption raises concerns since it is related to several both short- and long-term health effects (Higgins, 2010). The potential impact is still unclear given that merely adverse effects defined as "serious" (which means only those that cause inpatient hospitalization or death) are generally reported, while less serious effects are rarely reported (Clauson et al., 2008). Anyhow, while energy drinks are safe for the majority of consumers when used in moderation, the high caffeine content poses serious health risks for vulnerable people, as children and adolescents.

This paragraph reports several examples of the potential adverse effects of energy drinks and their components on health, with a particular focus on children and young adolescents.

2.4.1. Psychiatric consequences

Literature reports that numerous ingredients of energy drinks are potentially linked with manic episodes (Babu et al., 2008; Clauson et al., 2008; Reissig et al., 2009; Higgins, 2010), also in patients with no history of psychiatric illness (Ogawa and Ueki, 2007).

Specifically, two cases of mania have been reported in depressed patients when they started therapy with ginseng (Jones and Runikins, 1987; Gonzalez-Seijo et al., 1995; Clauson et al., 2008); another case is that of

a patient with no psychiatric illness, who experienced mania after having assumed 500 to 750 mg of ginseng for two months (Engelberg et al., 2001). The control of manic episodes continued after stopping ginseng/caffeine and starting conventional treatment. In this case, evidence shows that the patient's condition returned to normal within a month.

Finally, a young man with bipolar disorder treated with lithium for long time had a manic episode with consequent hospitalization after consuming three cans of Red Bull in two days (Machado-Vieira et al., 2001).

To conclude, even though only few cases are reported in the literature, the evidence shows that there are reasons for concern regarding intake of large amounts of the energy drinks ingredients, principally for patients with potential psychiatric problems. Further research is required in order to strengthen the evidence of long-term neuropsychiatric consequences of energy drink use.

2.4.2. Seizures

Seizures caused by caffeine may occur at low doses in susceptible individuals or as well as a result of overdose. Literature reports four cases of seizures in patients with large consumption of energy drinks containing caffeine, guarana, taurine, inositol, carnitine and vitamins (Iyadurai and Chung, 2007). At follow-up, no further seizures ware reported by patients after abstinence from energy drinks intake. Furthermore, patients did not report sleep deprivation, which means this consequence may be dose related and manifest in vulnerable people (Babu et al., 2008; Clauson et al., 2008).

2.4.3. Withdrawal

Medical literature well explains caffeine withdrawal symptoms, including yawning, fatigue, depression, anxiety and headache with cessation of caffeine (Bernstein et al., 1998; Reissig et al., 2009). Those symptoms commonly occur within 12 to 24 hours of cessation, peak at 20 to 48 hours, and may continue for up to one week (Griffiths and Woodson, 1988; Babu et al., 2008).

Several examples of caffeine withdrawal in teenagers (Hale et al., 1995; Bernstein et al., 2002; Oberstar et al., 2002) and children (Goldstein and Wallace, 1997; Bernstein et al., 1998) have also been documented. For instance, one study of children verified decreased response time during the caffeine withdrawal phase. Furthermore, those children showed decreased attention for up to one week after cessation of caffeine use (Bernstein et al., 1998). Supplementary implications as to variability in caffeine ingestion and attention need further analysis, given the potential repercussions of long-lasting inattention in children.

2.4.4. Renal health

As stated in the previous paragraph, caffeine intake is mainly related to its diuretic function. Notwithstanding this, prolonged use may lead to a decreasing effect. Anyway, it is important to bear in mind that energy drinks represent a different kind of beverage from sports drinks, whose main function is rehydration required during athletic exercise or by fluid loss (Maughan and Griffin, 2003; Braganza and Larkin, 2007).

2.4.5. Overweigh and obesity

The problem of obesity is increasing worldwide, and various factors can contribute to this trend. Beyond lifestyle, recent studies have indicated caffeine and sucrose contained in energy drinks as potential causes of weight gain (Bray et al., 2004). A study investigated the effects on fat of either an energy drinks or sucrose alone (Rush et al., 2006). The ten women in that study report increased carbohydrate oxidation, but decreased lipid oxidation consequent to energy drinks consumption. Furthermore, the analysis reported that sucrose and caffeine may increase hyperglycemia, a problem for children with diabetes. To face this health issue, some energy-drink producers reformulated their products to diminish the glucose or sugar content (Clauson et al., 2008).

2.4.6. Dental health

Regular and sizeable intake of acidic beverages may be related with dental erosion. Some experiments have been done in order to assess the effects of these drinks on extracted teeth (Clauson et al., 2008). The studies indicated that immersion in caffeine-based energy drinks for a certain period provokes a considerable reduction in enamel hardness; this result is much higher compared with other beverages (Seow and Thong, 2005; Von Fraunhofer and Rogers, 2005). Certainly, these studies would not be a great issue for consumers of modest quantities of energy drinks.

2.4.7. Athletic performance

As stated in the previous section, energy drinks are frequently used during or before challenging athletic activities. Some experts state that the enhancement is mainly due to caffeine, and so energy drink intake by athletes is ineffective (Cohen, 2001; Clauson et al., 2008). On the other hand, a well-formulated sport drink or even water consumption represent a proper choice (ADCAPS, 2010).

2.5. Energy drinks combined with alcohol

The practice of mixing energy drinks with alcohol represents an emerging trend and is becoming progressively popular (Oteri et al., 2007; O'Brien et al., 2008). Alcohol is a sedative, while common ingredients of energy drinks such as caffeine, guarana and taurine have a stimulant effect. For this reason, people who assume high quantity of caffeine together with high quantity of alcohol may not realize the extent to which they are intoxicated.

The simultaneous consumption of energy drinks masks the effects of alcohol. It prolongs the drinking session by keeping the individual awake longer and, thus, it may leads to excessive alcohol assumption. Concerning this point, several studies reveal that young people who regularly consume alcohol mixed with energy drinks more often binge drink and are drunk twice as often (Hughes et al., 1997; Ferreira, 2006; Malinauskas et al., 2007; O'Brien, 2008; ADCAPS, 2010; EUCAM, 2010). This can happen both because

they do not realize the real quantity of alcohol consumed and because people who like risky behaviour are more like to binge-drink.

Apart from the risky effects this mixture may have on cardiac function, numerous studies report that who consumed energy drinks with alcohol experienced a reduced capacity in feeling symptoms - such as headache and weakness - but were still impaired in terms of visual reaction time and motor coordination (Ferreira et al., 2006; Clauson et al., 2008). The indicated practice could lead to engagement in risky behaviours and physically hazardous activity, such as sexual assault and driving while intoxicated, with potential related injuries and deaths (Riesselmann et al., 1996; Cohen, 2001; Markovits and Grossman, 2004; O'Brien et al., 2008). In contrast, White and Swartzwelder (2005) state that adolescents seem to be less susceptible than adults to both the sedative and motor impairing effects of alcohol, which makes alcohol use more appealing.

Another concern is that the adolescent brain is still developing, thus it is particularly vulnerable to the toxicity of alcohol (Adriani and Laviola, 2004; Brown and Tapert, 2004; Spear, 2004; White and Swartzwelder, 2005). Principally the prefrontal cortex, which represents the part of the brain involved in decision-making and impulse control. The prolonged effects of this practice on the developing brain are still not known, though it has been associated with later depression in some cases (Markovits and Grossman, 2004; Mason et al., 2008; Greenemeier, 2010).

It is important to recognise that mixing alcohol with highly caffeinated energy drinks is not comparable to consuming mixed drinks such as rum and Coke, since those contain much lower level of caffeine.

Recent studies report that, whether or not mixed with alcohol, energy drinks consumption might represent a risk for alcohol dependence and maybe nonmedical prescription drug intake; anyhow, the mechanisms through which these associations exist are still not clear (Arria et al. 2010; Arria et al., 2011).

Furthermore, there is strong evidence that caffeine is linked with consequent substance dependence syndrome in some people (Strain et al., 1994; Hughes et al., 1998; Bernstein et al., 2002; Oberstar et al., 2002; Richards et al., 2004; Jones and Lejuez, 2005; Svikis et al., 2005). For example, studies in adults (Strain et al., 1994; Richards et al., 2004) and young individuals (Bernstein et al., 2002; Oberstar et al., 2002) have shown high rates of withdrawal and other serious problems related to caffeine dependence. A population-based survey demonstrated that 30% of a sample of 162 caffeine consumers satisfied diagnostic criteria for substance dependence when applied to caffeine (Hughes et al., 1998). Given these considerations, more detailed studies are needed in order to explain the relationship between mixing energy drinks with alcohol and the risk of alcohol intoxication.

3. The regulatory aspects of energy drinks and alcoholic beverage in Europe

This section presents a study on the various regulations of both energy drinks and alcoholic beverages (with a particular focus on alcopops) in Europe. Such restrictions, both those proposed and applied, are employed

to limit potential problems related to the consumption of these kinds of products, mainly by minors and young adults.

3.1. Regulation of content and advertisement of energy drinks

The consumption of energy drinks containing high levels of caffeine has spread in recent years. Moreover, a large quantity of new brands of energy drinks will be launched in the near future (see for instance: Johnson, 2006; Malinauskas et al., 2007; Reissig et al., 2009).

The wide availability of the beverages from stores makes them readily available to adolescents, even though the products are often sold for more than twice the price of traditional soft drinks (Babu et al., 2008; Clauson et al., 2008; ADCAPS, 2010).

The launch of energy drinks on the market raised concerns in many parts of the world and caught criticism by community groups. Critics explain the popularity of energy drinks, both alcoholic and non-alcoholic, by the marketing, which uses misleading messages and is believed to be highly appealing to young people (EUCAM, 2008).

Concerning energy drinks, the shape and colour of the packaging, the presence at sporting happenings and the dedicated sites on the Internet seem to be designed exclusively for adolescents. To advertise these drinks, most producers do not use conventional marketing tools. In other words, advertisement by television and radio commercials is uncommon, while sporting event and product placement in media oriented to minors or young adults represent a preferred strategy (Simon and Mosher, 2007; EUCAM, 2008; Seifert, 2011).

Internet is being used as a source of information for most energy drinks. These web sites have an age check, conditional on the legal drinking age that could be easily avoided. On the other side, internet can be used by Europeans to purchase energy drinks that are advertised but are not available on the European market (EUCAM, 2008; EUCAM, 2010).

The regulation of caffeine based drinks is particularly tough, to some extent because drinks such as coffee and tea, that naturally contain caffeine, have a long tradition. Nevertheless, a number of countries have enacted measures to control the labelling, distribution and sale of energy drinks that include significant quantities of caffeine (Reissig et al., 2009). This sort of regulation differs across countries and some examples are shown in Table 3.

Considering the high caffeine content of energy drinks, which varies considerably by products, and the aggressive marketing to young and inexperienced consumers, detailed labelling on the packaging would be required (Reissig et al., 2009). Concerning this topic, the European Union requires that this kind of beverages has a “high caffeine content” label (European Union, 2007). Moreover, product label warnings about hazards connected with the consumption of these products, either alone or mixed with alcohol, would also be appropriate. Given that producers of alcoholic energy drinks often produce non-alcoholic energy

drinks as well, a clear distinction in the name and packaging of the alcohol containing product would be required.[3]

Concerning the regulation of energy drinks, non-Member States seem to have more chances than EU Member States owing to trade agreements (EUCAM, 2010). Those countries have stringent restrictions on energy drinks with a high amount of caffeine and/or taurine. Several countries prohibited the sale of high-caffeine energy drinks, while others restricted the sale to pharmacies.

For national governments in EU Member States it is harder to apply severe regulations. When France restricted the sale of the non-alcoholic energy drink Red Bull, the manufacturers challenged that prohibition through the European Commission. The Commission stated that the caffeine and taurine concentrations in energy drinks had not been confirmed to jeopardize consumer's health and ordered France to withdraw the ban. The European Food Safety Authority (EFSA) has encouraged international research and data collection to better measure risks in minors and young adults. Red Bull has now been available in its original formula on the French market since 2008 (Medical News Today, 2004; EUCAM, 2008; EUCAM, 2010; Seifert, 2011).

Together with France, Denmark [4] and Norway have totally banned Red Bull for several years. Anyhow, those countries have had to subsequently lift the bans with the consequent re-legalization of energy drinks.

Sweden apply age limits on the sale of this product and require warning labels discouraging consumers from mixing this kind of drink with alcohol. Warning labels are also required for all cans marketed in Austria (where Red Bull originated and is still produced) and Italy. In 2008, authorities in Germany identified cocaine among Red Bull Cola ingredients. Red Bull manufacturers insisted that active cocaine was removed from the coca leaf during processing and that the extract was used for flavouring. Nevertheless, 11 of 16 German states forbade the product sale (EUCAM, 2008; Seifert, 2011).

It is important to notice that, in both Member and non-Member States, energy drinks available with restrictions do not include taurine or caffeine as a primary ingredient, but only alternative stimulant components such as guarana and ginseng. In this manner, alcohol producers have more chances to effectively circumvent present regulations. Nevertheless, guarana is caffeine-based; hence it is dubious whether such beverages are in agreement with present limitations in these countries (EUCAM, 2010).

Other Member States have less or nonexistent restrictive regulations on energy drinks. For instance, in 2003 the Finnish food safety authority (EVIRA) stated that indication of high caffeine content and the recommendation of not to be used by vulnerable people and with alcohol are printed in the packaging labels of this kind of beverage.

[3] For instance, a non-alcoholic product is employed in a campaign to prevent breast cancer, called 'Cult-Foundation'. Since both the non-alcoholic and alcoholic energy drink of Cult are on the market under the same brand name, the alcoholic energy drink can be easily connected with the prevention of breast cancer by the public opinion. This expedient seems to be employed by alcohol producers to avoid existing alcohol marketing regulations (EUCAM, 2010).

[4] In recent years it has been legal for Danish shops to sell energy drinks including caffeine. Nowadays, the packaging must carry a label warning that the energy drink contains a high level of caffeine. In September 2010, Denmark proposed stricter requirements to the cautions on the labels of energy drinks across the EU. This information is available at: http://www.allbusiness.com/retail/retailers-food-beverage-stores-convenience/12622796-1.html

In most of these countries without a ban on energy drinks, a higher number of these products can be found. These drinks are mostly produced by national or European manufacturers. Nevertheless, an increasing volume of American non-alcoholic energy drinks are introduced in the European market. The number of alcoholic energy drinks will almost certainly increase in the near future in European countries with no or only flexible regulations on alcoholic energy drinks.

An important aspect is represented by the legality of banning alcoholic energy drinks under EU law. Concerning this point, see for instance the discussion on health, alcohol and EU law made by Anderson and Baumberg (Anderson and Baumberg, 2008). As the authors state in their paper, the main commitments of Member States derive from the EU treaties signed by national leaders. These commitments are interpreted through the European Court of Justice in specific cases brought by either the European Commission or by interested parties. Even though Iceland, Lichtenstein and Norway lie outside the EU, those countries are included in the EU's internal market and are bound by the same laws as the EU countries since they have signed the European Economic Area (EEA) agreement.

EU law has gained a great importance into alcohol policy area. Decisions that used to be only subject to political pressures in several Member States are currently also subject to legal pressures at EU level. The European Court of Justice rulings have had real impacts on alcohol policy in the EU (Luedtke, 2004). Notwithstanding this, the decisions of the courts do not automatically modify the whole policy of a country. In fact, governments can vary their behaviour for a single case with no need of revising an entire policy; furthermore, they can avoid conforming to the judgement (Alter, 2000; Lenaerts and Heremans, 2006).

Many professionals in the alcohol field from the words of both alcohol industry and the academic see the role of the European Court of Justice as negative for health. However, both the European Court of Justice and European Free Trade Association (EFTA) Court have been designed to prioritise health over trade issues in relation to alcohol policies (Anderson and Baumberg, 2008).

3.2. Regulation of alcoholic beverage

Each country in the European Union applies a wide range of laws and other policies aimed at reducing the externalities associated with the harmful alcohol consumption and encourage responsible drinking patterns. These policies are most in favour of controls on advertising and drinks mainly targeted to young people, but evidence is quite scarce in this area. Although not all of these policies are specifically focused on minors and young adults, most of them are extremely relevant to that part of the population.

Following the recommendation by Anderson and Baumberg (2006), alcohol regulations can be assembled in several groups: policies limiting drinking and driving; controlling the alcohol market; supporting education and communication; supporting the reduction of damages in drinking and nearby environments; supporting interventions for individuals. More precisely, each of these groups of policies includes several regulations as follows:

1. The drinking-driving policies include lowered blood alcohol concentration (BAC) levels, unrestricted random breath testing, license suspension and lower BAC levels for young drivers. Those policies are extremely effective, but the evidence is limited.
2. Policies that control the alcohol market include taxation and managing the physical availability of alcohol, as elevating the minimum drinking age and restricting hours and days of sale. These taxes are very important in targeting young adults and the harms consequent to alcohol use. The evidence on the effectiveness of such policies is quite strong and shows that the extension of opening hours for the sale of alcohol results in more aggressive damage. Moreover, limiting the volume and content of commercial communications of alcohol products is likely to reduce harm. Advertisements have a significant effect in promoting virtuous behaviours.
3. School-based education programmes against alcohol consumption and the related harms are the most common in Europe. The literature reports that these interventions, offered either in schools or via social marketing, although providing practical information and improving knowledge, tend to be poorly or only moderately developed with consequent low effects.[5]
4. Among strategies targeted to reduce harm in drinking and surrounding environments, some can be listed as follows: responsible beverage service, enforcement of on-premise regulations, interventions focused on public transportation, safer drink containers. The literature shows growing evidence for the impact of those strategies. Nevertheless, these policies are appropriate to drinking in bars and restaurants, and their efficiency relies on adequate enforcement. Such strategies are also more effective if supported by community-based prevention programmes.
5. Policies supporting interventions for individuals are, for example, social welfare based programmes, recommendation to reduce alcohol intake during pregnancy or in the workplace, brief advice for unsafe alcohol use. The evidence for the effects of these policies is widespread.

Evidence shows that the most effective policies aimed to reduce dangerous alcohol consumption among young people are those that increase the retail price of alcohol, limit its availability, increase restrictions on inexpert drivers and provide brief recommendation in primary care situations. Nevertheless, applying harmonized several policies represents the most effective way to reduce alcohol-related damages. For a comparison between alcohol policies and their effectiveness see, among the others, works of Anderson and Baumberg (2006), Cnossen (2006), Mistral (2009), Rabinovich et al. (2009).

The following paragraphs are mainly focused on alcohol policies that limit drinking and driving and those that control the alcohol market.

3.2.1. The drinking-driving policies

[5] Alcohol information spending is very low worldwide, compared to advertisement of alcohol spending by industries. For example, UK Government spending on alcohol information campaigns in 2009 and 2010 was 17.6 million pounds (House of Commons, 2009) compared to the industry's spending of 800 million pounds on alcohol advertising in 2004 (IAS, 2008).

The limitation of drinking in inappropriate situations such as drink-driving represents a frequent alcohol policy. Other commonly limited areas are the workplace, probably due to both reduced productivity and a greater risk of workplace accidents, and public spaces as streets and parks, principally aimed to avoid public disorder (Anderson and Baumberg, 2006).

3.2.1.1. The Blood Alcohol concentration (BAC) levels

In Europe, the illegal Blood Alcohol Content (BAC) levels[6] have always been established by national legislations. However, the concerns of European institutions led the European Commission to propose a draft Directive in 1988 to harmonise illegal BAC limits at the level of 0.5 mg/ml in all Member States. In that moment only Finland, Netherlands, Portugal and Sweden already included this restriction in their national legislations. The Commission's proposal was thought to send a clear and coherent message to the drivers in the whole Community; however, it did not succeed given that several Member States denied the competence of the European legislation.

Then, the European countries have individually decided to harmonise their illegal BAC limit to the indicated level of 0.5 mg/ml using their national legislation and inspired by the European Commission's activity. A peer effect based on regions has been significant (Albalate, 2007; Rabinovich et al., 2009).

The Blood Alcohol Levels and related countries can be listed as follow:

- 0.0 mg per ml - Estonia, Malta, Romania, Slovakia, Czech Republic, Hungary;
- 0.2 mg per ml - Norway, Poland, Sweden;
- 0.4 mg per ml – Lithuania;
- 0.5 mg per ml - Belgium, Bulgaria, Denmark, Germany (Germany is 0.3 if you're in an accident), Finland, France, Greece, Italy, Serbia/Montenegro, Croatia, Latvia, Macedonia, Netherlands, Austria, Portugal, Slovenia, Spain, Turkey, Cyprus (North);
- 0.8 mg per ml - UK, Ireland, Luxembourg, Malta, Switzerland;
- 0.9 mg per ml - Cyprus (South).

3.2.1.2. Unrestricted breath testing

Unrestricted or random breath testing means that the police have the chance of stopping drivers and ask to take a breath test. In the Netherlands, the implementation of experimental random breath testing led to a fall of the number of drivers with alcohol in their blood, but especially drivers with BAC levels above the national legal limit of 0.5 g/L (Mathijssen and Wesemann, 1993).

3.2.1.3. License suspension

Licence suspension to drunk and potentially dangerous drivers to be effective requires some form of education or treatment program. Any penalty to be credible needs to be certain and immediate. The literature

[6] BAC (sometimes called BAL, blood alcohol level) represents the amount of ethanol in a given amount of blood and is noted as "weight by volume." The most commonly used measurements are grams of ethanol per 100 millilitre of blood (g/100ml), sometimes expressed as percentage by volume commonly used in the US and milligrams of ethanol per millilitre of blood (mg/ml), equivalent to grams per litre (g/L) used in many parts of Europe. For instance, 0.05 g/100ml=0.05%=0.5 mg/ml=0.5g/L.

reports a review of 46 studies on license suspension followed by an average reduction of 5% in alcohol-related accidents and of 26% in fatal crashes (Zobeck and Williams, 1994; Anderson and Baumberg, 2006).

3.2.2. Policies that regulate the alcohol market: tax, availability, marketing

Policies that control the alcohol market have a considerable effect in reducing fatalities related to drinking and driving, but they need a certain degree of harmonization. This kind of policy includes controls on the price, the availability and the promotion of alcoholic beverages (Grube and Stewart, 2004).

3.2.2.1. Prices and taxes in the EU

Extensive evidence shows that raising alcohol prices leads to decreased consumption and related harms on a societal level. However, the real price of alcoholic drinks is falling in many countries, included those in Europe (WHO, 2004). Additionally, these regulations are not constantly applied to public health aims. In fact, in many EU countries, and sometimes provincial or state governments within them, alcohol pricing and taxation are used principally as fiscal rather than public health instruments, with alcohol being considered primarily an economic commodity (Rabinovich et al., 2009). Notable exceptions to this are the traditionally higher taxation levels of Scandinavian countries (leaded by Sweden and Finland) and taxation of alcopops in some countries.[7]

Alcohol taxation can not only be used to increase the price of alcohol; it has the added benefit of increasing fiscal revenue for government (Sheron et al., 2008). The steadiness of alcohol taxation is partially owed to the fact that public agencies may be averse to the raise of alcohol taxes since this would influence not only binge and dependent drinkers, but also occasional drinkers (Chaloupka et al., 2002). This issue raises a dispute among different sectors within the alcohol area. Another controversial matter is the degree to which certain alcohol pricing policies, such as higher taxation, could improve smuggling and illegal manufacture of alcoholic products. Then, policy-makers have to find a solution to balance the reduction of alcohol damages and of the costs and negative consequences related to alcohol policies (Rabinovich et al., 2009).

Current levels of taxation and the cross border alcohol problem

Prices of many goods, included alcoholic beverages, differ considerably across European countries. Notwithstanding this, harmonization of excise duties is an established objective of the European Union, since consumers actually take benefit of these price differentials and engage in cross border arbitrage.

With the integration of the European Union and its enlargement , the consequences of cross border trade has become an important policy matter, since in many cases the price differences are consequent to taxes set by individual Member States, with important consequences for tax revenues (Asplund et al., 2005).

[7] Wine-producing countries like France, Italy and Spain on the other hand, have tended to levy very low or nonexistent excise duty rates on wine, to support the wine industry and maintain high levels of sales. Generally speaking, compared to beer and wine, spirits are much more heavily taxed in EU.

Moreover, it has been argued that several countries rival others in attracting foreign demand by lowering taxes (Kanbur and Keen, 1993).

Little is known about the scale of cross border shopping (Keen, 2002), but empirical evidence verifies that distance to the border is important for the extent of cross border arbitrage (Asplund et al., 2005).

Considering alcohol, the extent of cross-border purchase has raised. For this reason, the European Commission has made several proposals for the harmonisation of excise duties on alcoholic beverages in the EU since the early Seventies. A proposal made in 1992 was finally accepted, which was restricted to the introduction of minimum excise duty rates rather than complete harmonisation.[8] Anyhow, while these minimum rates are binding, the Member States have the chance of deciding their own excise duty levels above this minimum (Rabinovich et al., 2009).

Rabinovich et al. (2009) offer the analysis of three case studies on cross-border alcohol consumption: UK-France, Finland-Estonia and Sweden-Denmark-Germany. All of these cases present significant differences in alcohol taxation and price between the countries. The combination of such tax differences and reduced controls on imports for personal use has lead to significantly raised cross-border alcohol consumption. As already stated in general, the cross-border purchases not only reduced the tax revenues collected by national tax authorities, but it also led to a raise in consumption in the receiving countries.

Taxation on alcopops

Given the high level of alcohol consumption and harms among young people in recent years, several European countries have focused their efforts in the taxation of alcopops.

France raised taxation on alcopops in 1996, assuring to use the revenue from this tax on programmes to fight alcoholism. In 2002, alcopops were classified as distilled spirits in the United Kingdom; they were subject to spirits excise duty with a consequent increase in their price. In 2004, Germany re-classified alcopops, leading to an increase in taxation to higher levels than those of spirits. In the same period, the Swiss government reclassified alcopops as well, producing a special tax of four times higher than that for distilled spirits. Special taxes on alcopops have been imposed in Luxembourg and Denmark, and they have been considered in the Netherlands and Sweden. (Anderson and Baumberg, 2006; Rabinovich et al., 2009).

With the introduction of higher alcopop taxes in some countries, the consumption of spirit-based alcopops declined moderately. An almost identical decline in alcopop consumption in Germany and Switzerland was also observed in Austria, where no comparative tax increase had been introduced (Uhl, 2007). Notwithstanding this, there is yet little consistent research regarding the effectiveness of these special alcopop taxes in dropping alcohol consumption and damages particularly among young drinkers (Babor et al., 2003; Metzner and Kraus, 2008). Even in reported cases of reductions on alcopop sales, it remains unclear whether drinkers reduced the general alcohol consumption, or just substitute alcopops with other

[8] Council Directive 92/83/EEC instructs Member States on how to define the products and product categories to be taxed, and defined the principles of how to set the excise duty rates for these products. Council Directive 92/84 EEC established a set of minimum rates for distilled spirits, beer and intermediate products (such as fortified wines and liqueur wines); no minimums was proposed for wine and fermented beverages other than wine and beer (Cnossen, 2006).

alcoholic products. A case study can be offered by Switzerland, where alcopops are consumed in addition to traditional alcoholic drinks instead of replacing them (Wicki et al. 2006). This fact could imply that at least in this country, a drop in alcopops consumption would lead to a general reduction of alcohol consumption. A final consideration is that increased awareness of young people may also play an important role (Rabinovich et al., 2009).

Minimum prices

Legislation setting minimum prices for alcohol with the aim of curbing alcohol related harms is also unusual among EU countries. This policy has until recently been not considered an acceptable or feasible measure by the European courts most likely because minimum prices is viewed as a trade-distorting tool by the European courts, given that it set an artificial price floor restraining and distorting price competition. However, there are regulations in some European countries that operate as 'proxies' for minimum price regulations. A well-known example is represented by Germany, where the "Apple Juice law" requires that in the on-premise trade, at least one alcohol-free drink must be cheaper than the cheapest alcoholic drink available (Rabinovich et al., 2009).

Several European countries limit sales promotions or under cost, such as "two for one" and temporary price-cuts known as "happy hour". While Belgium, Luxembourg, Poland and other few countries ban these kinds of sales, others apply either self-regulation only is in place or no restrictions at all. Unluckily, both data and robust evidence of the impact of these promotions and discounts on alcohol consumption and harms is still limited. Further research is therefore required to shed light on this issue (Rabinovich et al., 2009).

3.2.2.2. Restrictions on alcohol availability

Broad restrictions on eligibility to purchase alcohol were fairly common in the past. Nowadays, although a total embargo is clearly not possible to apply in Europe, restrictions on alcohol sales for specific persons in the population, as minors or young people, or in specific circumstances are necessary to limit alcohol related problems.

Since the mid of the Nineties, alcoholic beverages have become more and more available in Europe, apart from Italy. This situation was a consequent to a general increase of income, while the relative price of alcoholic drinks has remained relatively stable or even decreased (Rabinovich et al., 2009).

Concerning young people, several studies have shown that they are sensitive to alcohol price changes. As a matter of fact, price increases lead young people to reduce the incidence of drinking and also to reduce quantities drunk per drinking event (Anderson, 2007; Meier et al., 2008). Unfortunately, there is extremely limited evidence of the impact of alcohol availability on youth drinkers.

Controlling sales to young people

Besides the general restrictions on availability, almost all countries legally limit the sale of alcohols, even if the age at which young people may purchase alcohol differs extensively from country to country, ranging

from 16 to 20 years of age. As showed in Table 4, it is evident that different countries view the various types and places of alcohol in a different way when it comes to young people. Several countries present a more relaxed policy for off-premise sales than for on-premise. As a matter of fact, all countries prohibit the sale of alcohol to young people beneath a certain age in bars and pubs, but a couple of countries (Greece and Italy) have no policy on the sale of alcohol to children in shops. Moreover, most countries treat spirits more severely than beer or wine, with some exceptions.

Several studies show that regulations that increase the minimum legal drinking age diminish alcohol sales and related problems among young drinkers (Babor et al., 2003).[9] Occasionally, despite that law, young people do succeed in purchasing alcohol. Such sales result from weak levels of enforcement, especially when there is little community support. Consequently, to make the regulation effective the enforcement of the law is required (Grube, 1997; Wagenaar et al., 2000; Hibell et al., 2004).

On-premise and off-premise sales of alcohol

Alcohol can be bought through either "off-premise" or "on-premise" sales. On-premise refers to pubs, clubs, restaurants and other retailers selling alcohol for consumption within the venue. Off-premise refers to supermarkets and off-licences, selling alcohol for consumption elsewhere. These are also indicated as on-trade and off-trade sales of alcohol.

Regulations for off-premise sales can be done on the type, strength and packaging of the alcoholic beverage and the time, location and costs of alcohol sales. Regulations for on-premise sales can identify drink sizes, prohibit discount drink promotions and require on-premise staff to be trained concerning responsible beverage service. Furthermore, they may control the design of the place and include conditions on both alcohol- and non-alcohol-related matters (Anderson and Baumberg, 2006).

In general, there is a trend towards more off-trade alcohol use, since it is cheaper than alcohol sold on-trade. Although there is little research examining such issue, this has been identified as the main reason of the growing off-trade alcohol sales in several European countries, as Finland, Ireland, Latvia, Sweden, the Netherlands and the United Kingdom. Off-trade retailers, particularly supermarkets, can purchase large quantities of alcohol at lower prices through volume discounts. Additionally, a larger customer base for stores than for on-trade retailers facilitates higher discounting in off-trade retailers (Larken, 2007; Rabinovich et al., 2009).

A licence issued by the pertinent administration is compulsory in many European countries, either on-licensed premises or from off-licences, before the selling of particular types of alcoholic drinks. The advantages of licensing retail sales are numerous and they range from the certainty of the respect of other

[9] The examination of almost one hundred studies published during the second half of the last century shows a very strong evidence that variations in minimum drinking age laws can substantially affect youth drinking and alcohol-related harm. Several studies have found that raising the minimum legal drinking age from 18 to 21 years limits considerably crashes involving young drivers. Moreover, a study from Denmark, where a minimum 15-year age limit was introduced for off-premise purchases, found that there was an effect in dropping teenagers' drinking, but that the drinking of those above as well as below the age limit was affected. See Babor et al. (2003) and Anderson and Baumberg (2006) for a more detailed review concerning this topic.

regulations, such as age limits and opening times, to the confidence of tax is collected on the entire amount of alcohol sold (Anderson and Baumberg, 2006).

Sales of alcohol can be regulated through government-owned alcohol outlets, retail monopolies, nowadays relatively uncommon within the EU but still in force in some countries. Off-premise monopoly systems reduce alcohol consumption and alcohol-related issues. For example, the entire alcohol use in Sweden was considerably higher when medium-strength beer could be bought in grocery stores between 1965 and 1977, rather than only in state monopoly stores. Moreover, when Finland changed from selling beer only in government monopoly stores to selling it also in grocery stores in the late Sixties, alcohol consumption and related problems rose considerably (Anderson and Baumberg, 2006).

Outlet density

Concerning the number of outlets available for the retail purchase of alcohol, the smaller the number, the greater the difficulty in obtaining alcohol. This relation can be useful when the aim is to curb alcohol consumption and alcohol-related problems (Gruenewald et al., 1993).[10]

As instance, Finland and Sweden, which apply off-premise retail alcohol monopolies to limit outlet density and thus alcohol sales, experienced a significant impact on overall alcohol consumption and alcohol-related harm from changes in the number of outlets. In Finland, among other alarming consequences, mortality from liver cirrhosis raised by 50% (Poikolainen, 1980).

On the contrary, a study on a similar change occurred in Norway found that if alcohol is available in some ways, the effects on overall consumption of changes in the number of off-sale stores selling one or another type of beverage are minor (Mäkelä et al., 2002).

Days and hours of retail sale

Half of all Member States have legal sale restrictions on the places of sale of alcoholic drinks, but only few on the hours and days of sale (WHO, 2006). Several studies have shown that changing the times of alcohol sale merely redistribute the periods at which alcohol related negative events take place. Other evidence offered by Swedish and Norwegian studies show that limiting the times of sale reduces domestic violence and public drunkenness (Anderson and Baumberg, 2006).

3.2.2.3. Marketing and advertising regulation

As alcohol use in Europe has increased rapidly in recent years, the alcohol market has expanded accordingly. These sales are driven by vast promotional and marketing campaigns (van den Broeck and de Bruijn, 2010).

Alcohol producers state their target groups are adolescents aged 21 to 24 (Insights Beverage, 2007). However, in practice large numbers of adolescents have been exposed to alcohol marketing in recent years since the alcohol industry intensified their focus particularly on this group (Jernigan, 2001; CAMY, 2007).

[10] Jackson et al. (2009) offer a review of nineteen studies concerning the effects of changes in alcohol outlet density. Whilst outlet density usually undergoes gradual change over time, a number of situations, such as the privatisation of retail monopolies, provided a basis for natural experiments.

Creating brand loyalty among children and young people is sure investment for the industry in the long term (European Alcohol Policy Alliance, 2008).

As for energy drinks, the alcohol beverage industry uses a broad range of marketing tools to which young people are exposed in everyday life. These tools result in a wide range of marketing practices that span from television to event sponsoring, from promotional items to advertising in new media (BMA 2009). Furthermore, a marketing technique is for companies to sponsor parties on college campuses (ADCAPS, 2010).

A systematic review of longitudinal studies shows that exposure to alcohol marketing has a positive impact on the likelihood that children and young people will start drinking and that it increases the frequency and amount of drinking among those who already drink (Anderson et al., 2009; Smith and Foxcroft, 2009). For this reason, restricting amount of exposure to appealing alcohol advertisements can be a fundamental in curbing the harmful influences of alcohol marketing on young people's drinking.

Alcohol marketing regulations in Europe

Several Member States have partial or full mandatory or voluntary boundaries on advertising, promotion and labelling. A wide assortment of volume and content restrictions to regulated alcohol marketing exists throughout Europe.

In 2001, the European council and parliament prepared Council Recommendations, stating among other things that alcoholic drinks should not be designed or promoted to appeal to children. Almost all Member States have implemented these recommendations in statutory regulations and applied at the national level (STAP, 2007). Moreover, similar content restrictions are also present in self regulations (van den Broeck and de Bruijn, 2010).

The Council Recommendations are not legally compulsory. However, the singular binding regulation at the European level is the Audio Visual Media Services Directive (European Parliament and the Council, 2010). This directive helps to set minimum standards for alcohol advertising that aim to contribute to reducing consumption and harms, by regulating different types of television marketing. The directive specifies that "alcohol advertisements shall – among other things – not be aimed specifically at minors, shall not link the consumption of alcohol to enhanced physical performance, social or sexual success and shall not claim that it is a stimulant, a sedative or a means of resolving personal conflicts". Anyhow, volume restrictions or restrictions addressed alcohol advertising other than in television are not integrated in European law.

Alcohol marketing in Europe is mostly regulated at the national level. Active regulations widely differ by content and volume limits. Concerning volume, several kinds of limits exist in Europe, listed as follows: a complete prohibition of all types of alcohol marketing exercises in Norway; a restriction of marketing of certain group of alcoholic drinks, as for example the ban of wine and spirits marketing in Poland; a restriction of marketing in several media, as for example prohibiting alcohol advertising on television, radio and cinema in France; a restriction of the place or time period of marketing, as for example limitations on

marketing close to schools; a restriction of the position of alcohol promotion in media particularly targeted to children (van den Broeck and de Bruijn, 2010).

In the case that alcohol marketing is allowed, content boundaries can protect against misleading and appealing alcohol advertisements. At present, the content restrictions in most European alcohol marketing regulations employ a vague definition, only stating that "it may not be aimed specifically at minors" as required by the Audio Visual Media Services Directive. Critical voices recognize that most of the existing content guidelines are commonly ineffective given the high level of ambiguity (Hawkes, 2005).

As in many fields, France and Sweden represent positive exceptions. Content limits in those countries precisely state which elements are allowed in alcohol promotions. Moreover, alcohol advertisers are no longer authorized to include attractive features to children and adolescent (van den Broeck and de Bruijn, 2010).

4. Conclusions and final considerations

On the basis of this review on the supply side of alcoholic and non-alcoholic drinks with potentially particular appeal to minors in Europe, several points can be summarised as follow.

Concerning energy drinks, the literature review identifies that their use has become highly prevalent among children and young adults during last decades. Most of these products, also indicated as functional foods, are fortified drinks with extra dietary supplements (Clauson et al., 2008). Energy drinks are promoted for their supposed effects of increased stimulation. Notwithstanding this, no therapeutic benefits have been recognised to these beverages and the evidence, although scarce in some cases, suggests that they can potentially put some children at risk for severe negative health effects. As a matter of fact, caffeine and sugar are present in amounts known to have health effects, such as seizures, insomnia, obesity and mania (see for instance Seifert, 2011).

Several areas require investigation to further characterize the effects of long-term energy drinks use in children and adolescents. One of the most concerning is the combination of energy drinks with alcohol.

Energy drinks are aggressively marketed, particularly among children and adolescents, but are not always clear in providing ingredient information and concentrations on their labels.

It is quite hard for EU Member States to maintain a ban on these drinks owing to possible conflicts with EU trade agreements (EUCAM, 2010). The caffeine content of these products is currently unregulated. Several manufacturers declare that energy drinks represent nutritional supplements, attempting to circumvent the caffeine restrictions by employing guarana and ginseng instead of caffeine and taurine as stimulating ingredient. In general, however, the quantity of energy drinks is higher in countries without a ban on these products (EUCAM, 2010; Seifert, 2011).

A final consideration is that health care providers should inform and educate children and their families on the potential adverse effects of energy drinks; furthermore, industry should caution consumers about the adverse health consequences of mixing alcohol with energy drinks, both on their product labels and in their

advertising (Clauson et al., 2008; Higgins, 2010; van den Broeck and de Bruijn, 2010; Arria and O'Brien, 2011; Seifert, 2011).

Concerning alcoholic beverage, a new category of drinks has been introduced in the market, especially designed and marketed for adolescents and young adults. In recent years, there has been a raise among adolescents with earlier beginning and binge drinking in several European countries. It has to bear in mind that alcohol consumption and alcohol-related harms are multi-factorial issues. That means they are influenced by numerous factors, which include but are not limited to the availability of alcoholic beverages (Rabinovich et al., 2009).

The incidence of alcohol-related harms and their elevated social and economic costs, have led to rising public and policy attention in how to reduce them. Alcohol policy in Europe shows several similarities between countries but also numerous systematic differences. As instance, while all European countries have a collection of policies concerning alcohol, these are uncoordinated and missing a dominant strategy in some cases. These countries are relatively similar concerning blood alcohol limits for drivers, licences for alcohol sales, the existence of a minimum age to purchased alcohol and some form of alcohol education in schools. On the contrary, extensive differences can be traced in the enforcement of drink-driving regulations, the precise age at which young people can purchase alcohol, limits on alcohol availability and advertisement. In particular, the tax rates in various European countries are very different, with the lowest rates found in southern and parts of central and eastern Europe (Anderson and Baumberg, 2006).

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Table 1. Energy drinks: common ingredients, therapeutic uses and adverse effects.

Ingredient	Description	Therapeutic uses	Purposed effect	Adverse Effects (due to idiosyncratic reaction or excessive dosage)
Caffeine	An adenosine receptor antagonist: a central nervous system stimulant	As caffeine citrate, used to treat apnea and broncho-pulmonary dysplasia in premature infants	Increases exercise endurance and improves cognition and mood when fatigued or sleep-deprived	Nervousness, irritability, anxiety, insomnia, tachycardia, palpitations, upset stomach, vomiting, abdominal pain, rigidity, hypokalemia, altered consciousness, paralysis, hallucinations, increased intracranial pressure, cerebral edema, seizures, rhabdomyolysis, supraventricular and ventricular tachyarrhythmias
Guarana	A South American plant that contains large amounts of caffeine, theobromine, and theophylline (a chronotrope and an inotrope) and tannins	None known	Stimulant, increases energy and enhances physical performance, mainly through the effects of caffeine; promotes weight loss	Insomnia, nervousness, restlessness, tachycardia, tremors, anxiety, chest pain, dysrhythmia
Taurine	An abundant amino acid in the central nervous system; acts in neural growth and protection, cell metabolism, osmoregulation, antioxidation, and glycolysis; estimated daily intake is 400 mg/d	Infant formula has been supplemented with taurine since the 1980s because of evidence that it promotes healthy development; used to treat alcohol withdrawal, congestive heart failure, cystic fibrosis, palpitations/dysrhythmias, hypertension, diabetes, seizure disorders, hepatitis	Marketed to promote eye and biliary health and to prevent congestive heart failure by lowering blood pressure while improving cardiac contractility. Lowers risk of diabetes and epilepsy	Insufficient reliable evidence to suggest any adverse events at this time
L-Carnitine	An amino acid involved in β-oxidation of fatty acids	Used as a therapeutic supplement in congenital and acquired-deficiency states, end-stage renal disease, valproate toxicity, and dementia; increases attention and decreases hyperactivity in certain populations of children; nonstimulant L-acetylcarnitine is used to treat ADHD in boys with fragile X syndrome and, in 1 study, children with typical ADHD; it may also protect against heart disease	Added to promote fat metabolism, improve endurance and protect against cardiovascular disease	In high doses, can cause nausea, vomiting, abdominal pain, and diarrhea; has been reported to cause seizures in patients with no known disease and to increase seizure frequency in patients with seizure disorder
Ginseng	An East Asian herb	Believed to improve memory, increase stamina, and stimulate immune function	Speeds illness recovery; improves mental, physical, and sexual performance; controls blood glucose, and lowers blood pressure	Reported symptoms of ginseng toxicity include diarrhea, vaginal bleeding, amenorrhea, headache, tachycardia, edema, vertigo, mania, hypertension, rashes, insomnia, irritability, Stevens- Johnson syndrome, and agranulocytosis; some of these symptoms may be related to contaminants, such as phenylbutazone and aminopyrine, used in its processing

Sources: Heneman and Zidenberg-Cherr (2007); Clauson et al. (2008); Seifert et al. (2011).

Table 2. Ingredients of selected energy drinks based on 8.0- to 8.4-ounce servings

Product name	Ginseng (mg)	Taurine (mg)	Guarana (mg)	Caffeine (mg)	Sugar (grams)	Calories
Arizona Caution	100	1,000	0	100	33	100
Extreme Energy Shot Cocaine	0	750	25	280	18	
Full Throttle (a)	90	605	0.70	72	29	111
Monster (a)	200	1,000	49	80	27	100
Pimp Juice	0	7	100	81	34	130
Red Bull	0	1,000	0	80	27	110
Rockstar Energy (a)	25	946	200	80	27	140
Rockstar Juiced (b)	25	1,000	25	80	21	90
SoBe Adrenaline Rush	50	1,000	50	79	33	140
SoBe No Fear (a)	50	1,000	50	87	33	130
Spike Shooter	0	0	0	300	0	0

Sources: Heneman and Zidenberg-Cherr (2007); Babu et al. (2008); Clauson et al. (2008); Reissig et al. (2009).
Notes: 1 cup = 8 fluid ounces; 1 ounce ≈ 28.35 grams; 8 ounces ≈ 226.8 grams.
(a) Sold as a 16-ounce can; consumption of one can is the equivalent of double the listed ingredients.
(b) Sold as a 24-ounce can; consumption of one can is the equivalent of triple the listed ingredients.

Table 3. National and International Energy Drinks Regulations.

Country	Bans on Energy Drinks	Restrictions	Proposed or Attempted Regulation
Denmark	—	—	Prohibited energy drinks entirely
France	—	—	Banned Red Bull but recently removed the ban after assessment by the European Food Safety Authority
Germany	11 of 16 German states banned Red Bull Cola because of trace amounts of cocaine	—	Stricter regulations on warning labels have been requested by the government; the German Federal Institute for Risk Assessment recommends that energy shots be banned because of the high risk of overdose
Ireland	—	—	Ireland is reviewing energy drinks safety; Ireland's food-safety board has recommended that energy drinks be labeled as unsuitable for children <16 y old and that a ban be placed on the promotion of Red Bull in sporting events and in combination with alcohol
Netherlands	—	—	Reviewed energy drinks safety and declared no risk
Sweden	—	Sales to children <15 y are banned; warning labels about consuming high caffeine after exercise and mixing energy drinks with alcohol are also present	—
Finland	—	—	Drinks that contain >150 mg/L of caffeine must be labeled "high caffeine content" and also must be labeled "not recommended for children, pregnant women, or people sensitive to caffeine"; energy drinks must also state the maximum amount to be used daily"
United Kingdom	—	—	The UK's Committee on Toxicity investigated Red Bull and determined that it was safe for the general public but that children <16 y old or people sensitive to caffeine should avoid drinks with high caffeine content
European Food Safety Authority	—	Beverages that contain >150 mg/L caffeine should be labeled "high caffeine content" and the exact amount present indicated on the label	—
Norway	—	Energy drinks can only be sold in pharmacies	—
Turkey	Ban on all high-caffeine energy drinks	—	—

Source: Seifert et al., 2011

Table 4. Minimum legal age limits for purchasing alcoholic beverages in Europe

	Country	Minimum legal age limit for the purchase of alcohol ON-PREMISE		Minimum legal age limit for the purchase of alcohol OFF-PREMISE	
		Beer & Wine	*Spirits*	*Beer & Wine*	*Spirits*
1	Belgium	16	18	16	18
2	Bulgary	18	18	18	18
3	Cyprus	18	18	18	18
4	Denmark	18	18	16	16
5	Germany	16	18	16	18
6	Estonia	18	18	18	18
7	Finland	18	18	18	20
8	France[1]	18	18	18	18
9	Greece	16	16	None	None
10	Ireland	18	18	18	18
11	Hungary	18	18	18	18
12	Italy	16	16	None	None
13	Latvia	18	18	18	18
14	Lithuania	18	18	18	18
15	Luxembourg	16	16	16	16
16	Malta	17	17	17	17
17	Netherlands	16	18	16	18
18	Austria[2]	16	16-18	16	16-18
19	Poland	18	18	18	18
20	Portugal	16	16	16	16
21	Romenia	18	18	18	18
22	Slovenia	18	18	18	18
23	Slovak Rep.	18	18	18	18
24	Spain[3]	16-18	16-18	16-18	16-18
25	Czech Rep.	18	18	18	18
26	UK	18	18	18	18
27	Sweden	18	18	20	20

1. The French law in which the minimum legal purchasing age for alcohol is raised to 18 years was promulgated in July 2009. The decree will be signed shortly (necessary for the law to come into force).
2. In 4 federal states in Austria, the age limit for the sales of spirits is 16 years.
3.The minimum legal age limit in Spain is 18 years in all but 4 (of the 17) regions.
On-premise sale = selling of alcoholic beverages for consumption at the site of the sale (e.g. restaurants, bars, pubs, etc.).
Off-premise sale = selling of alcoholic beverages for consumption elsewhere and not on the site of sale (e.g. supermarkets, liquor stores).

Source: STAP – Dutch Institute for Alcohol Policy, 2010

Notes: Of the entire number of Members States of the European Union:

- 17 countries have an age limit of 18 years or older for the purchase of alcohol, in on-premise as well as off-premise sales.
- Austria, Belgium, Denmark, Germany and The Netherlands have a combination of age limits of 16 and 18.
- Luxembourg and Portugal have one single age limit of 16 years, and Malta country has a single age limit of 17 years.
- Greece and Italy have an age limit for on-premise sales of 16 years, but no age limit for off-premise sales.

Iceland and Norway are not members of the EU, but they belong to the European Economic Area with the EU as European Free Trade Association (EFTA) Member countries. In Iceland there exists one age limit of 20 years for all types of beverages in the on-and off-trade. In Norway, the age limit for beer and wine is 18 in on as well as off trade; for spirits there is one age limit of 20 years.

Annex I

Search strategy employed so far for searching initial evidence and material on "mapping the market" of ABPPAMs

The main search engines used were Pub Med and Google Scholar, by using the following terms, separately or in combination:

- Alcohol, drink, beverage, liquor, ethanol, energy drink, alcopops, pre-mixed cocktails, binge drinking
- minor, teenager, adolescent, child, student, scholar, youth, young
- Europe, Member States
- regulation, policy, law, market, marketing, advertise, supply, sale, consumption, demand, outlet

The author limited the search to English-language and foreign-language articles with English-language abstracts, from 1990-2011. A select few relevant articles were published in French, Dutch or German. The author investigated those articles too, attempting to extract the most relevant information.

The author screened the collected papers by examining the abstracts in each identified reference. Whenever a given article appeared relevant for the study, she attempted to download the full document in order to study it in detail. In several occasions the download was not allowed, hence the author attempted to exploit all the relevant information included in the abstract. Google scholar was also used to search for relevant citing articles.