(ALDH). Unfortunately for the consumer, the immediate metabolite of ethanol, acetaldehyde, is toxic, mutagenic, and carcinogenic.

$$CH_3CH_2OH \xrightarrow[k_1]{ADH} CH_3CHO \xrightarrow[k_2]{ALDH} Acetyl-CoA \qquad \text{(Eqn. 1)}$$

[0005] It can be seen from Equation 1 that when the rate of the ALDH-catalyzed reaction (k_2) is not high enough to keep pace with the rate of the ALD-catalyzed dehydrogenation of ~~ethanol (k_2)~~ ethanol (k_1), acetaldehyde will accumulate. High acute concentrations of acetaldehyde *in vivo* (acetaldehydemia) can lead to undesirable effects such as cardiovascular complications, drowsiness, nausea, headache, asthma and facial flushing, while chronic acetaldehydemia can lead to cirrhosis and esophageal cancer. Another unfortunate result of acute acetaldehyde toxicity, well known to heavy drinkers, is the hangover. A person with a hangover will experience dizziness, fatigue, headache, nausea, muscle aches, vomiting, sensitivity to bright light, or sensitivity to noise, and most often a combination of these unpleasant symptoms, for a period of time typically lasting from 12 to 36 hours.

[0006] It is well established that acetaldehyde is the culprit in hangovers and in alcohol-induced facial flushing, and it is the principal suspect in alcohol-associated cancers as well *vide infra*. Acetaldehydemia can occur as a result of heavy alcohol consumption, leading to saturation of ALDH activity, or as a result of light or moderate alcohol consumption in the presence of abnormally high ADH activity or inadequate ALDH activity ($k_1 >> k_2$ in Equation 1). Inherited defects in both enzyme systems are known to lead to acetaldehydemia-related syndromes. (D.W. Crabb, M. Matsumoto, D. Chang, M. You, *Proc. Nutr. Soc.* **2004**, 63:49–63.)

acetaldehyde-1-d (CH_3CDO) (G.J. Hart and F.M. Dickinson, *Biochem. J.* **1978,** 175:899-908), and horse liver ALDH shows no isotope effect when acting upon propionaldehyde-1-d (CH_3CH_2CDO) (R.I. Feldman and H. Weiner, *J. Biol. Chem.* **1972**, 247:267-272). In order to avoid any possible reduction in ALDH activity, it can be desirable to have little or no deuterium at H_{Si} in the compound of Formula 1, and correspondingly little or no production of CH_3CDO. It should however be understood that lowering the *in vivo* acetaldehyde concentration by providing deuterium at H_{Re} of ethanol, by the methods of the present invention, should reduce the symptoms of acetaldehydemia regardless of the isotopic composition of H_{Si}.

[0024] It will be appreciated that even in individuals *not* suffering from an enzyme abnormality, consumption of the compositions of the invention in place of equivalent prior art beverages and pharmaceutical formulations should still lead to slower formation of acetaldehyde *in vivo*, with attendant reduction of the symptoms of acetaldehydemia. The slower metabolism of the deuterated alcohol of the invention, in combination with the extended period of peak blood alcohol concentration, should reduce the amount of alcohol needed to produce a given psychopharmacological effect. The beverages of the present invention, accordingly, can be manufactured with a lower alcohol content than equivalent prior art beverages without being perceived by consumers as "weaker" or less potent, and they should produce a more consistent and prolonged effect with a less-pronounced initial effect. In particular, the beverages of the invention may be consumed on an empty stomach, with less risk of a sudden onset of inebriation.

[0025] Conversely, pharmaceutical compositions can be produced having higher ethanol concentrations and greater solvent power than prior art compositions, without an increase in

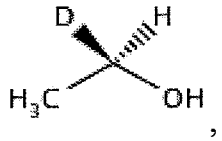
embodiments of the invention, the amount of ethanol is at least 2%, 5%, 10%, 20%, or 40% by weight. "Deuterated alcohol," in the context of this document, refers to ethanol having at least one deuterium atom, and corresponding to Formula 1. Deuterated alcohols are articles of commerce sold by vendors such as CDN Isotopes, Inc., Pointe-Claire, Quebec, Canada, and methods for making such compounds are well known to those of skill in the art. Ethanol stereospecifically deuterated at the H_{Re} position is known (see Damgaard *et al.*, *Biochemistry*, **1981** 20:5662-9, and references therein), while racemic ethanol-1-d is readily obtained by reduction of acetaldehyde with BD_3 or $NaBD_4$. Non-specific hydrogen-deuterium exchange reactions are referenced and/or discussed in U.S. Pat. No. 7,517,990, which is incorporated by reference into this document in its entirety for all purposes, and particularly for the purpose of disclosing methods of ~~deut~~*er*~~ium~~ deuterium incorporation. Hydrogenation *of a* vin*yl ester (e.g.*, vinyl acetate) with D_2 gas, followed by hydrolysis, will provide ethanol-1,2-d_2 having at least 50% D at the H_{Re} position; the proportion of D at this position may be raised, if desired, by the use of an asymmetric hydrogenation catalyst. (See, *e.g.*, G.J. Clarkson *et al.*, *Tetrahedron: Asymmetry,* **2004**, 15:1787-1792.)

[0036] "Enzyme abnormality" in the context of metabolism of ethanol refers to either a decreased aldehyde dehydrogenase level or an increased level of activity of alcohol dehydrogenase, or both, which results in higher than normal levels of acetaldehyde in the body of an affected person. Although this is most commonly the result of allelic variations in the genes encoding the enzymes, other causes (*e.g.* misregulation of gene expression) are encompassed by the present invention.

[0037] References herein to methods of "avoiding" or "reducing the severity" of symptoms of acetaldehydemia should be understood to refer to an avoidance or reduction relative to the

WE CLAIM:

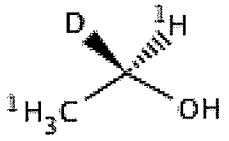
1. An alcoholic beverage, comprising: water, ~~and~~ deuterated ethanol, and an additional component suitable for the alcoholic beverage, wherein the beverage is suitable for human consumption and 0.25 to 60% by weight of the beverage is ~~at least 5 mole percent of the ethanol is a~~ deuterated alcohol having the formula



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wherein each H may independently be hydrogen or deuterium.

2. The alcoholic beverage of claim 1, wherein ~~at least 5 mole percent of~~ the deuterated ethanol is a deuterated alcohol having the formula



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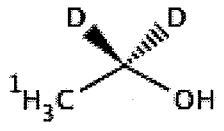
3. The alcoholic beverage of claim 2, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

4. The alcoholic beverage of claim 2, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

5. The alcoholic beverage of claim 2, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

6. The alcoholic beverage of claim 2, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

~~3.~~7. The alcoholic beverage of claim 1, wherein ~~at least 5 mole percent of~~ the deuterated ethanol is a deuterated alcohol having the formula



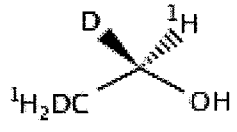
8. The alcoholic beverage of claim 7, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

9. The alcoholic beverage of claim 7, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

10. The alcoholic beverage of claim 7, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

11. The alcoholic beverage of claim 7, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

~~4.~~12. The alcoholic beverage of claim 1, wherein ~~at least 5 mole percent of~~ the deuterated ethanol is a deuterated alcohol having the formula



13. The alcoholic beverage of claim 12, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

14. The alcoholic beverage of claim 12, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

15. The alcoholic beverage of claim 12, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

16. The alcoholic beverage of claim 12, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

~~5.~~17. The alcoholic beverage of claim 1, wherein ~~at least 5 mole percent of~~ the deuterated ethanol is a deuterated alcohol having the formula CD_3CD_2OH.

18. The alcoholic beverage of claim 17, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

19. The alcoholic beverage of claim 17, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

20. The alcoholic beverage of claim 17, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

21. The alcoholic beverage of claim 17, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

~~6. The alcoholic beverage of claim 1, wherein at least 15 mole percent of the ethanol is said deuterated alcohol.~~

~~7. The alcoholic beverage of claim 6, wherein at least 30 mole percent of the ethanol is said deuterated alcohol.~~

~~8. The alcoholic beverage of claim 7, wherein at least 50 mole percent of the ethanol is said deuterated alcohol.~~

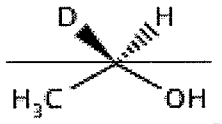
~~9. The alcoholic beverage of claim 8, wherein at least 75 mole percent of the ethanol is said deuterated alcohol.~~

~~10. The alcoholic beverage of claim 9, wherein at least 95 mole percent of the ethanol is said deuterated alcohol.~~

~~11. A method of delaying the onset of ethanol-induced symptoms associated with the consumption of an alcoholic beverage, which comprises the consumption of an alcoholic beverage according to claim 1.~~

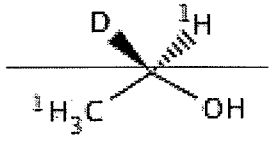
~~12. A method of avoiding or reducing ethanol-induced acetaldehydemia in an individual, comprising providing to said individual an alcoholic beverage according to claim 1.~~

~~13. A method of making an alcoholic beverage according to claim 1, comprising the step of adding to a beverage a deuterated alcohol having the formula~~

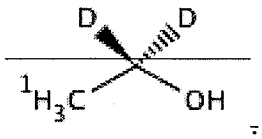


~~wherein each H may independently be hydrogen or deuterium.~~

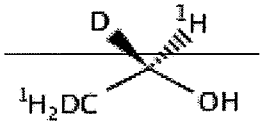
~~14. The method according to claim 13, wherein the deuterated alcohol has the formula~~



~~15. The method according to claim 13, wherein the deuterated alcohol has the formula~~

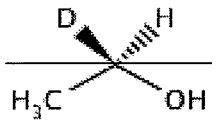


~~16. The method according to claim 13, wherein the deuterated alcohol has the formula~~



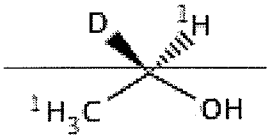
~~17. The method according to claim 13, wherein the deuterated alcohol has the formula CD_3CD_2OH.~~

~~18. A pharmaceutical composition comprising an active pharmaceutical ingredient and ethanol, wherein at least 5 mole percent of the ethanol is a deuterated alcohol having the formula~~

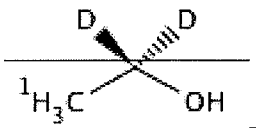


~~wherein each H may independently be hydrogen or deuterium.~~

~~19. The pharmaceutical composition of claim 18, wherein at least 5 mole percent of the ethanol is a deuterated alcohol having the formula~~

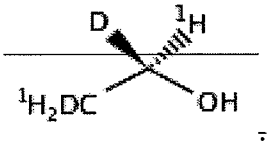


~~20. The pharmaceutical composition of claim 18, wherein at least 5 mole percent of the ethanol is a deuterated alcohol having the formula~~



~~21. The pharmaceutical composition of claim 18, wherein at least 5 mole percent of the ethanol~~

~~is a deuterated alcohol having the formula~~



~~22. The pharmaceutical composition of claim 18, wherein at least 5 mole percent of the ethanol is a deuterated alcohol having the formula CD_3CD_2OH.~~

~~23. The pharmaceutical composition of claim 18, wherein at least 15 mole percent of the ethanol is said deuterated alcohol.~~

~~24. The pharmaceutical composition of claim 23, wherein at least 30 mole percent of the ethanol is said deuterated alcohol.~~

~~25. The pharmaceutical composition of claim 24, wherein at least 50 mole percent of the ethanol is said deuterated alcohol.~~

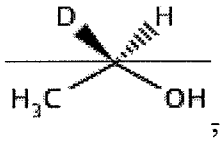
~~26. The pharmaceutical composition of claim 25, wherein at least 75 mole percent of the ethanol is said deuterated alcohol.~~

~~27. The pharmaceutical composition of claim 26, wherein at least 95 mole percent of the ethanol is said deuterated alcohol.~~

~~28. A method of avoiding or reducing the severity of ethanol-induced facial flushing in an~~

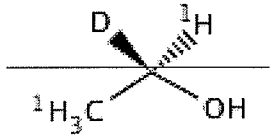
~~individual, comprising providing to said individual a pharmaceutical composition according to claim 18.~~

~~29. A method of making a pharmaceutical composition according to claim 18, comprising the step of combining an active pharmaceutical ingredient with a deuterated alcohol having the formula~~

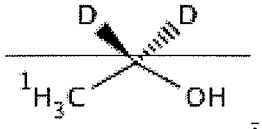


~~wherein each H may independently be hydrogen or deuterium, in an amount sufficient to produce a composition wherein at least 5 mole percent of the ethanol in the composition is said deuterated alcohol.~~

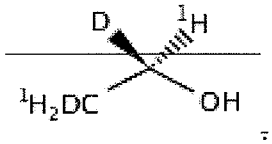
~~30. The method according to claim 29, wherein the deuterated alcohol has the formula~~



~~31. The method according to claim 29, wherein the deuterated alcohol has the formula~~



~~32. The method according to claim 29, wherein the deuterated alcohol has the formula~~



~~33. The method according to claim 29, wherein the deuterated alcohol has the formula CD_3CD_2OH.~~

22. The alcoholic beverage of claim 1, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

23. The alcoholic beverage of claim 1, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

24. The alcoholic beverage of claim 1, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

25. The alcoholic beverage of claim 1, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

26. The alcoholic beverage of claim 1, wherein from 1 to 40% by weight of the composition is deuterated alcohol.

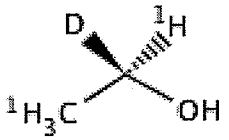
27. The alcoholic beverage of claim 26, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

28. The alcoholic beverage of claim 26, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

29. The alcoholic beverage of claim 26, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

30. The alcoholic beverage of claim 26, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

31. The alcoholic beverage of claim 26, wherein the composition deuterated ethanol is a deuterated alcohol having the formula



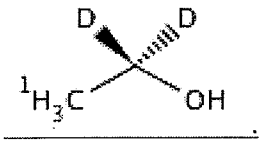
32. The alcoholic beverage of claim 31, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

33. The alcoholic beverage of claim 31, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

34. The alcoholic beverage of claim 31, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

35. The alcoholic beverage of claim 31, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

36. The alcoholic beverage of claim 26, wherein the composition deuterated ethanol is a deuterated alcohol having the formula



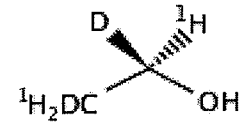
37. The alcoholic beverage of claim 36, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

38. The alcoholic beverage of claim 36, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

39. The alcoholic beverage of claim 36, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

40. The alcoholic beverage of claim 36, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

41. The alcoholic beverage of claim 26, wherein the composition deuterated ethanol is a deuterated alcohol having the formula



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42. The alcoholic beverage of claim 41, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

43. The alcoholic beverage of claim 41, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

44. The alcoholic beverage of claim 41, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

45. The alcoholic beverage of claim 41, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.

46. The alcoholic beverage of claim 26, wherein the composition deuterated ethanol is a deuterated alcohol having the formula CD_3CD_2OH.

47. The alcoholic beverage of claim 46, wherein the additional component is a sweetener that is suitable for the alcoholic beverage.

48. The alcoholic beverage of claim 46, wherein the additional component is an odorant that is suitable for the alcoholic beverage.

49. The alcoholic beverage of claim 46, wherein the additional component is a flavorant that is suitable for the alcoholic beverage.

50. The alcoholic beverage of claim 46, wherein the additional component is a congener derived from a brewed or fermented composition that is suitable for the alcoholic beverage.