What proof is in your Christmas pudding? Is caring under the influence possible?

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MJA 2014; 201: 702-704
doi: 10.5694/mja14.01478

Abstract

Objectives: To determine the ethanol concentration of commonly available Christmas puddings, and to extrapolate the blood alcohol content (BAC) of typical health care professionals after Christmas lunch at the hospital.

Design and setting: We conducted fractional distillation of Christmas puddings and analysed the distillate for ethanol content. We then applied standard pharmacological and physiological assumptions to assess predicted BAC in typical male and female health care professionals at our hospital.

Main outcome measures: Ethanol concentration of each pudding; estimated BAC of health care professionals after ingestion and at the end of a 30-minute lunch break.

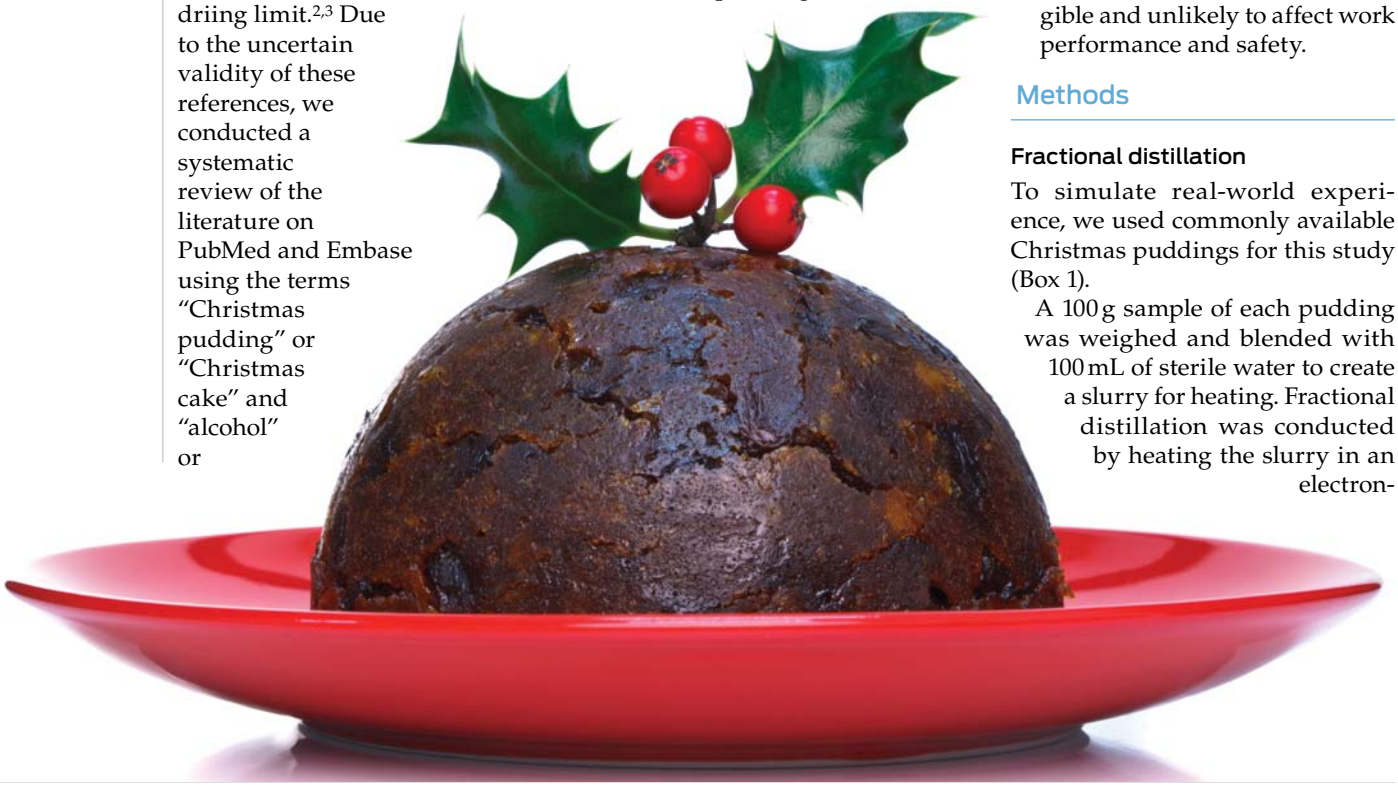
Results: The concentration of ethanol in common Christmas puddings ranged from 0.260 to 1.685 g per 125 mg slice. The concentration of ethanol per pudding was not greater than the stipulated specifications on the packaging, where shown. After pudding ingestion, the theoretical BAC of a typical 70 kg male and 60 kg female health care professional ranged from 0.001 to 0.004 g/dL and from 0.001 to 0.006 g/dL, respectively. Neither male nor female staff had a predicted BAC > 0.000 g/dL by the end of the lunch break.

Conclusion: Christmas puddings contain ethanol that does not all evaporate during the cooking process. However, the rise in BAC after ingestion of a typical slice of Christmas pudding was negligible and unlikely to affect work performance or safety or impair a health care worker's ability to make complex decisions.

The humble Christmas pudding began as a traditional porridge full of raisins and dried fruit that people shared during the Christmas festivities. It was only in the 16th century that butter, eggs and flour became part of the recipe, resulting in a boiled pudding.[1] Since then, there have been many variations that have incorporated all forms of fortified spirits, such as brandy, sherry and whisky. Secret recipes are age-old traditions passed down from generation to generation.

The traditional method allows the flavour to mature over a period of months, during which time the alcohol content of the moist pudding mixture preserves the ingredients. At the completion of flavour maturation, the pudding is boiled in a sealed container.

Controversy exists over the alcohol content of the Christmas puddings enjoyed on the 25th of December. Previous reports have listed the potential for the alcohol content of Christmas puddings to raise the blood alcohol content (BAC) to more than the legal driing limit.[2,3] Due to the uncertain validity of these references, we conducted a systematic review of the literature on PubMed and Embase using the terms "Christmas pudding" or "Christmas cake" and "alcohol" or "blood alcohol concentration". This search produced five studies that were reviewed by two independent researchers. None of these publications investigated the alcohol content and likely effects on BAC of ingestion of a typical slice of Christmas pudding.



We aimed to determine the ethanol concentration of a selection of Christmas puddings in Australia, and to extrapolate the BAC of a typical health care professional at our institution after lunch on Christmas Day. We hypothesised that any change in BAC would be negligible and unlikely to affect work performance and safety.

Methods

Fractional distillation

To simulate real-world experience, we used commonly available Christmas puddings for this study (Box 1).

A 100 g sample of each pudding was weighed and blended with 100 mL of sterile water to create a slurry for heating. Fractional distillation was conducted by heating the slurry in an electron-

ically controlled water bath to the boiling point of ethanol (78.37°C) and held at that temperature for 10 minutes. Volume of the distillate was measured, and it was transferred to a watch glass. The weight of ethanol in each distillate was determined by the mass difference after combustion of the retrieved distillate.

Ethics approval was not required for this study. No commercial agreement was undertaken. The clinicians involved provided all funding required for the purchase of the puddings. All chemistry laboratory time and equipment were supplied by the School of Science and Health at the University of Western Sydney.

Estimated blood alcohol concentration

To calculate the estimated peak BAC immediately after the enjoyment of Christmas pudding and at the completion of a 30-minute lunch break, we adapted the Widmark formula[4] as:

$$EBAC = \frac{0.806 \times \frac{AC}{10} \times 1.2}{BW \times Wt} - (MR \times IP)$$

where AC is the alcohol content (g) of a standard 125 g slice of Christmas pudding, BW is the body water constant (0.58 for men and 0.49 for women), Wt is body weight (kg), MR is the metabolism constant (0.017) and IP is ingestion period (min).

We assumed that hospital staff at the Christmas lunch would share a 1 kg Christmas pudding cut into eight slices of 125 g each; and that typical male and female health care professionals weigh 70 kg and 60 kg, respectively.

Since ingested ethanol has a rapid and 100% absorption from the gastrointestinal tract,[5,6] we calculated the consumption peak BAC from complete instantaneous absorption and assumed no other ethanol-containing food or drink were consumed over the lunch break.

Impairment

In accordance with work safety legislation and our institution's local policy,[7-9] we deemed the maximum BAC unlikely to impair health workers' performance and safety to be 0.05 g/dL.

Results

Each of the Christmas puddings had ethanol in the mixture, with a wide range in concentrations (Box 1).

The estimated BAC calculated using the adjusted Widmark formula for each pudding is shown in Box 2. After applying our assumptions, we found that the peak BAC did not exceed 0.05 g/dL at any stage. While the female BAC levels were higher, due to variations in body water composition and weight, neither the male nor female staff had a predicted BAC > 0.000 g/dL by the end of the lunch break.

Discussion

Christmas pudding is traditionally soaked in ethanol for flavour maturation and to retard the rate and chance of spoilage. Despite previous research in this field,[10] it is a common misconception that all the alcohol evaporates during the cooking process. We have shown in this study that this is not the case. While we found that some alcohol evaporated during the cooking process, we believe this correlated with the difference between the quantity specified on the packaging ingredients table and the quantity of alcohol distilled from the sample. Our fractional distillation did not recover greater levels of alcohol from the products where the alcohol concentration was specified. Interestingly, the two products sold by charities (Father Mac's Heavenly Pudding and Lion's Traditional Pudding) did not stipulate the amount of alcohol content, only that it was contained therein.

We used standard physiological and pharmacological assumptions and adapted the Widmark formula[4] to show that after the consumption of a 125 g slice of pudding during a 30-minute Christmas Day lunch, a

1 Alcohol content listed on package and results of fractional distillation for Christmas puddings tested

Pudding brand	Package-listed alcohol content	Pudding sample weight in solution (g)	Volume of distillate (mL)	Combustion mass difference alcohol (g)
Newcastle's Pudding Lady	4.0 mL/100 g	101.06	2.76	0.80
Coles Matured Christmas Pudding	3.5 mL/100 g	100.61	2.75	0.83
David Jones Christmas Fruit Pudding	3.0 mL/100 g	100.07	1.10	0.37
Woolworths Select Festive Sparkle Christmas Pudding	1.9 mL/100 g	100.16	3.80	1.35
Father Mac's Heavenly Pudding	Not listed	100.93	1.40	0.21
Lion's Traditional Pudding	Not listed	100.90	1.10	0.30

2 Typical health care professionals' blood alcohol content (BAC) after ingestion of Christmas pudding

		Calculated BAC (g/dL)					
		After ingestion		End of lunch break		Time to zero BAC (min)	
Pudding brand	Ethanol per 125 g slice (g)	Male	Female	Male	Female	Male	Female
Newcastle's Pudding Lady	0.990	0.002	0.003	0.000	0.000	8	11
Coles Matured Christmas Pudding	1.031	0.002	0.003	0.000	0.000	9	12
David Jones Christmas Fruit Pudding	0.462	0.001	0.002	0.000	0.000	4	5
Woolworths Select Festive Sparkle Christmas Pudding	1.685	0.004	0.006	0.000	0.000	14	20
Father Mac's Heavenly Pudding	0.260	0.001	0.001	0.000	0.000	2	3
Lion's Traditional Pudding	0.372	0.001	0.001	0.000	0.000	3	4

health care professional will not elevate his or her BAC by more than a very small amount. We have supported our hypothesis that consumption of Christmas pudding is unlikely to affect work performance or safety or impair a health worker's ability to make complex decisions.

Our study had some limitations, including the breadth of Christmas pudding market coverage. Due to limited funding, we were not able to assess every pudding on the market, only those that were most readily accessible. In addition, we did not include homemade pudding, which theoretically would contain ingredients of a higher quality and potentially higher alcohol content. As such, the results of our study may not be representative of the BAC levels obtained after ingestion of homemade pudding.

Although the fractional distillation used in this research was robust, future work may focus on more sophisticated chemical analysis of the pudding slurry. To complete the calculations of BAC for this study, we made substantial assumptions regarding the typical size of Christmas pudding slices and the average weights of male and female health care professionals at our institution. These are avenues of research that could be clarified in future assessment.

It is reassuring to note that to obtain a BAC >0.05 g/dL under the physiological parameters defined in our study, the average health care professional would need to eat in excess of 1 kg of the most potent Christmas pudding in a single sitting — a feat infrequently seen in our institution.

In conclusion, we found that the rise in BAC after ingestion of a typical slice of Christmas pudding is negligible and completely metabolised by the end of a 30-minute lunch break. Hospital staff should feel confident that the enthusiastic consumption of Christmas pudding at work in the festive season is unlikely to affect their work performance or safety, impair their ability to make complex decisions or compromise the standard of patient care.

Acknowledgements: We acknowledge Chris Mylecharane, Shane Griffin and Kumudu Perera from the School of Science and Health, University of Western Sydney, for assisting with analytical chemistry.

Competing interests: No relevant disclosures.

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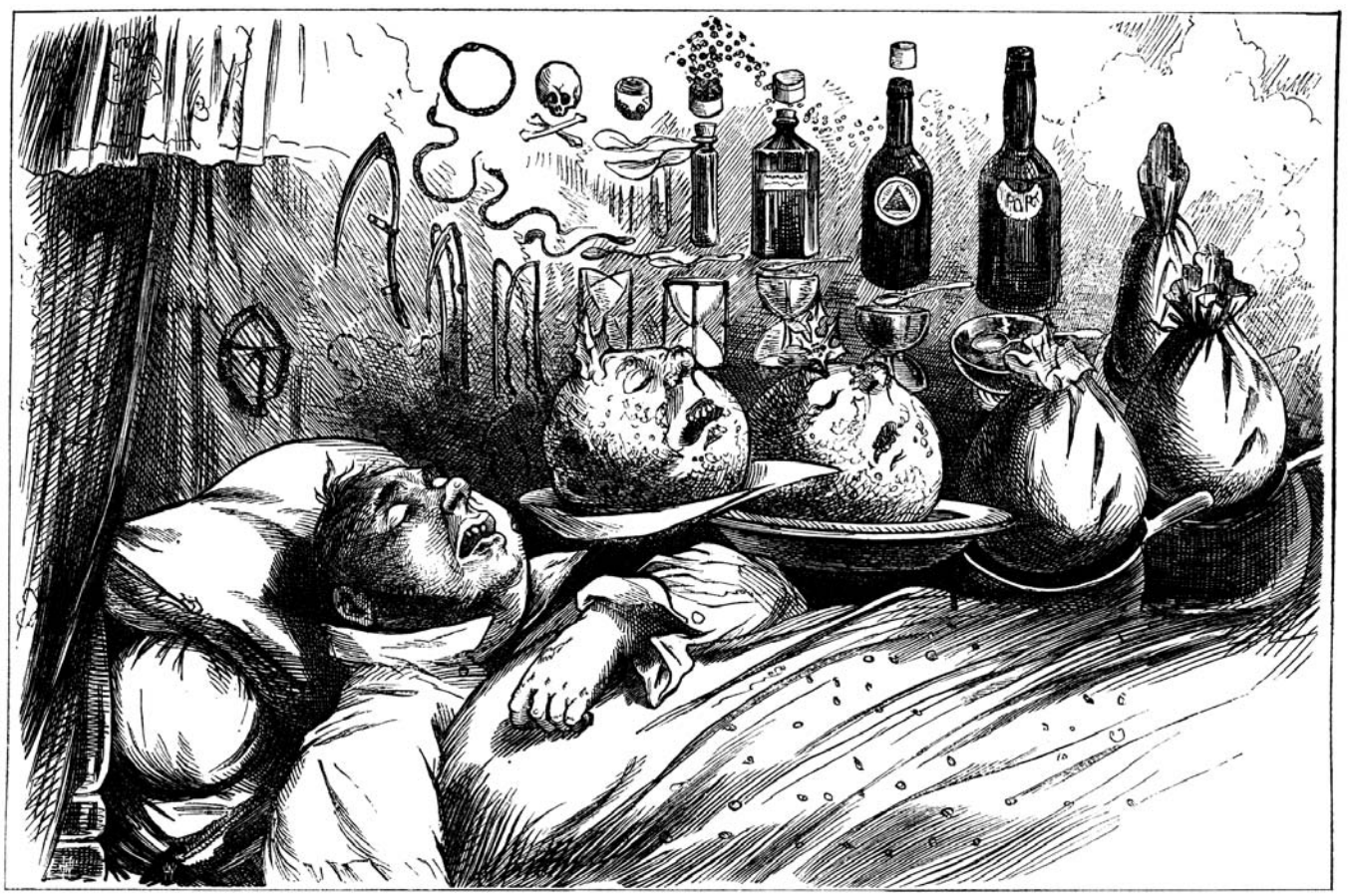

CHRISTMAS DREAMS.—I. A DREAM OF PUDDING.