The CRECHE study: testing the urban myth that chocolate Santa Clauses are re-wrapped Easter Bunnies

Dirk Stengel[1], Alexander Hönning[2], Stephan Just[3], Sven Mutze[4], Axel Ekkernkamp[3], Tobias Ohmann[5], Hajo Haase[6], Patric Kröpil[5], Leonie Gölz[4]

The known: Seasonal chocolate figurines are often given to inpatients and health care professionals during the Christmas season. If unsold chocolate Easter Bunny figurines are re-used as chocolate Santa Clauses (and vice versa), as is widely believed, it would pose a potential threat to hospital hygiene.

The new: Independent rating of whole body computed tomography scans by blinded radiology experts indicated that the inner structures of chocolate Christmas Santas and Easter Bunnies are dissimilar, inconsistent with the recycling of chocolate figurines.

The implications: There is no radiological evidence for chocolate Santa Clauses being re-used Easter Bunnies, allowing us to give and consume seasonal sweets in hospitals with a clear conscience.

Abstract

Objective: To test the urban myth that surplus chocolate Easter Bunnies are re-packaged as Santa Clauses for the following Christmas holiday season.

Design: Prospective radiographic cohort study of seasonal chocolate figurines, supplemented by anonymous 5-item questionnaire survey of belief in the re-wrapping myth (Generic Risk Items Noted by Chocolate consumers in Health care settings; GRINCH).

Setting: Two tertiary referral trauma centres in Germany (Berlin and Duisburg).

Participants: Eighteen chocolate Easter Bunnies and 15 chocolate Santa Clauses from different manufacturers purchased during 2020; 502 randomly selected people passing through the entrance halls of the two hospitals during 16 September – 12 October 2020.

Main outcome measures: Whole body computed tomography (WBCT) images of chocolate Easter Bunnies and Santa Clauses assessed by four independent, board-certified radiologists using a visual contour resemblance scale (CRS); survey participants' views on statements related to the re-wrapping myth.

Results: Expert examiners clearly distinguished the WBCT images of chocolate Easter Bunnies and Santa Clauses; the mean difference in CRS was 84.2 points (95% CI, 78.5–90.0 points), with excellent inter-observer agreement (mean intra-class correlation coefficient, 0.99; 95% CI, 0.99–1.00). A total of 214 survey participants (43%) disagreed and 145 (29%) agreed with the proposition that seasonal chocolate figurines are re-packaged and re-sold the following season.

Conclusion: Although about one-third of our survey respondents did not rule out the possibility of seasonal sweets being re-used, WBCT imaging found no similarity between chocolate foil-wrapped Easter and Christmas figurines, providing solid evidence against this urban myth. Chocolate Santa Clauses are unlikely to pose a significant threat to hospital food hygiene requirements.

Trial registration: Current Controlled Trials, ISRCTN16847363 (prospective).

Christmas is often a difficult time for people staying and working in hospitals. Small chocolate treats such as Santa figurines can help make the day just a little sweeter for both patients and health care professionals, and are therefore often given as presents during the holiday season.

A widespread urban myth is that unsold chocolate Easter Bunny figurines are re-packaged in seasonal foil and returned to shelves as chocolate Santa Clauses. Should there be any grain of truth in this myth, the strict hygiene chains intended to prevent hospital patients and personnel from food-borne, transmissible bacterial (eg, *Salmonella* and *Clostridium* spp.) and viral (eg, norovirus) disease may be compromised.

The Federal Association of the German Confectionery Industry (BDSI) has repeatedly denied the accusation of re-packaging, as food hygiene legislation prohibits re-use of already delivered products.[1]

While the coronavirus disease 2019 (COVID-19) pandemic has highlighted the importance of protecting patients and health care professionals from imported pathogens, earlier food-borne infections that posed significant public health threats did not receive much media attention.[2]

Screening methods are required to ensure that chocolate gifts do not contain any potentially harmful ingredients. Researchers in Manchester found that computed tomography (CT) imaging is suitable for revealing the complex structure of (seasonal) sweets.[3]

The objective of our study was to use CT imaging to test the urban myth that seasonal chocolate figures are re-wrapped and re-sold. We also developed a questionnaire to survey medical and non-medical hospital employees, patients, and visitors about their beliefs about the re-packaging hypothesis.

Methods

The CRECHE (Computed tomography to Rebut the myth that chocolate Easter and Christmas Hollow figurines are re-used and may not be safely Edible) study was conducted at two tertiary referral trauma centres in Germany (Berlin and Duisburg) and their departments of radiology. The study was prospectively registered with Current Controlled Trials (2 July 2020; https://www.isrctn.com/ISRCTN16847363).

Our hypothesis was that the belief that chocolate Easter Bunnies are re-packaged as Santa Clauses for re-sale is an unsubstantiated urban myth. Low dose CT imaging is a fast and reliable

[1] BG Kliniken: Klinikverbund der gesetzlichen Unfallversicherung gGmbH, Berlin, Germany. [2] Centre for Clinical Research, BG Klinikum Unfallkrankenhaus Berlin, Berlin, Germany. [3] BG Klinikum Unfallkrankenhaus Berlin gGmbH, Berlin, Germany. [4] Institute of Radiology and Neuroradiology, BG Klinikum Unfallkrankenhaus Berlin, Berlin, Germany. [5] BG Klinikum Duisburg, Duisburg, Germany. [6] Institute of Food Chemistry, Technical University of Berlin, Berlin, Germany. dirk.stengel@bg-kliniken.de • doi: 10.5694/mja2.51346

screening tool for depicting the inner shapes and contours of hollow chocolate seasonal figurines. If CT images of Santa Claus and Easter Bunny figurines from the same manufacturer are similar, it could not be excluded that the products were re-used and should therefore be enjoyed with caution. Clear differences between the figurines, however, could help refute the legend.

In the absence of reliable prior information, our investigation was exploratory. Our objectives were:

- to investigate with CT imaging the morphological features of the internal structure of chocolate figurines from various manufacturers (including the mean and maximum chocolate layer thicknesses of the entire figure and its base);
- to compare the radiological appearance of Easter Bunnies and Santa Clauses, as assessed by blinded expert examiners; and
- to survey the views of a random sample of volunteers about five statements regarding the urban myth of re-wrapped seasonal sweets.

Figurine selection and initial assessment

Members of the investigator group independently purchased, at their discretion, commercial chocolate Easter Bunnies and Santa Claus figurines of any size and shape from any manufacturer during the Easter and Christmas seasons of 2020. Duplicates were retained as reserves but excluded from the analysis. Specimens were assigned unique identification numbers and physically measured without removing the foil (maximum height, width, and depth, measured with a tape measure; weight determined on a kitchen scale).

Computed tomography imaging and evaluation

We used a 128-row multi-slice detector scanner (Definition AS+, Siemens) for non-contrast whole body computed tomography (WBCT). In accordance with the ALARA (as low as reasonably achievable) principle of radioprotection, we employed a low dose WBCT imaging protocol, with the following parameters: fixed tube voltage, 80 kVp; adapted tube current, ~9 mAs, regulated by real time dose modulation software (CARE Dose 4D, Siemens); collimation slice (cSL), 0.6 mm; and rotation time (Ti), 0.3 s.

Images were reconstructed as 2 mm slices in axial, coronal, and sagittal planes with a standard kernel. 3D imaging volume rendering techniques were applied using post-processing software (either ISP Portal, Philips, or syngo.via, Siemens). Radiologic indices included maximum height, width, and depth of the figurine, as well as the maximum chocolate layer thickness in three regions of interest (bottom, top, and lateral walls). As various approaches to automated image analysis proved unreliable in a pilot study, these morphometric characteristics were measured manually. All images were transferred to our institutional Picture Archiving and Communication Systems for further processing and evaluation. Expert ratings were made on a 100 mm visual contour resemblance scale (CRS) (online Supporting Information, figure 1).

Survey questionnaire

After Christmas sweets became available in supermarkets (September 2020!), visitors, patients, and staff passing the public entrance areas of the two participating hospitals, where displays explained the background of the study, were randomly approached by study assistants and invited to participate in an anonymous poll, using the Generic Risk Items Noted by Chocolate-consumers in Health care settings (GRINCH) pen-and-paper questionnaire (Likert scale; online Supporting Information, figure 2). Each respondent received one textile face mask as an incentive to participate. Protective measures to avert COVID-19 transmission (face masks, minimum distance of 1.50 m, alcohol-based hand disinfection) were followed in compliance with the German *Infection Protection Act* (*Infektionsschutzgesetz*).

Outcomes

The primary outcome was the mean difference in CRS ratings by four independent, board-certified radiologists of WBCT images of the Easter Bunny and Santa Claus figurines. This part of the investigation was conducted during 2–18 December 2020. Observers were blinded to brand and type while judging whether the contour and shape of the chocolate object resembled the Easter Bunny or Santa Claus. Co-primary outcomes were inter-observer agreement and individual ratings. The secondary outcomes were the results of the GRINCH survey.

Sample size

We did not attempt a formal sample size calculation, as reliable prior information, validated assessment instruments, and minimally relevant effect sizes were not available. For the CRECHE study experimental imaging component, we adhered to the pragmatic rule of thumb for pilot studies (12 participants per group), which allowed both a reasonable number of research WBCT timeslots in otherwise busy trauma centres and sufficient precision for quantitative analyses.[4] For the GRINCH questionnaire survey, we assumed that evaluable results from 20 patients and 20 employees per study site (80 participants in total) would be sufficient to gain insight into the prevalence of the urban myth of chocolate re-wrapping.

As our study gained unexpected interest among passers-by and their willingness to participate was great, we decided to leave this part of the CRECHE study open until at least 400 eligible questionnaires had been collected. All data were stored in the secuTrial electronic data capture system (interActive Systems), complying fully with the European Union *General Data Protection Regulation 2016/679*.

Statistical analysis

Descriptive statistics reported include proportions, means with standard deviations (SDs), and mean differences with 95% confidence intervals (CIs). Inter-observer agreement was quantified with the intra-class correlation coefficient (ICC) and visualised in scatter diagrams. Statistical analyses were conducted in SPSS 25.0 (IBM Deutschland) and Stata 16.0.

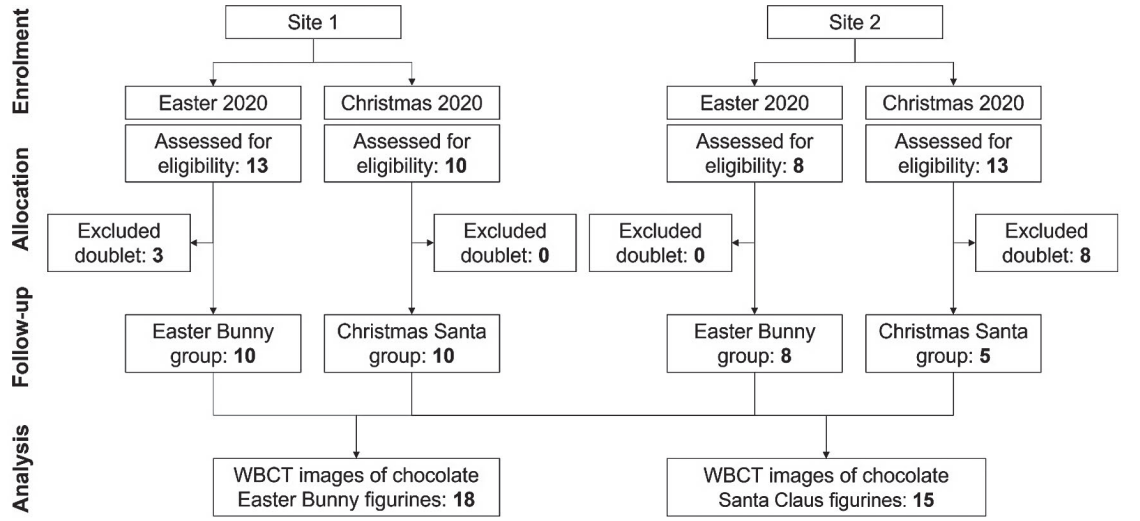
Ethics approval

The institutional review board of the Berlin Chamber of Physicians (*Ärztekammer* Berlin) approved the investigation plan and issued a participant consent waiver.

Results

Between 9 April and 15 May 2020, CRECHE investigators bought 21 chocolate Easter Bunnies from eleven manufacturers (dates of expiry, 4 July 2020 – 20 February 2021). Between 20 October and 7 November 2020, the investigational sample was completed by 23 chocolate Santa Clauses from eleven manufacturers (best-before dates, 1 March 2021 – 1 January 2022). After excluding doubles,

1 Flow diagram of the selection of chocolate figurines for the imaging component of the CRECHE study



WBCT = whole body computed tomography. ◆

18 Easter Bunnies and 15 Santa Clauses were included in our analysis (Box 1, Box 2).

Expert examiners could clearly distinguish chocolate Easter Bunnies from Santa Clauses by their WBCT appearance (Box 3; Supporting Information, figures 3–5). The mean difference in CRS score between Bunnies and Santas was 84.2 points (95% CI, 78.5–90.0 points). Inter-observer agreement for CRS ratings was excellent (mean ICC, 0.99; 95% CI, 0.99–1.00).

A total of 502 participants contributed to the GRINCH survey during 16 September – 12 October 2020 (277 women, 199 men, 26 of diverse or not specified gender), including 408 who supplied complete data (Supporting Information, figure 6); 109 participants were aged 20–34 years (22%), 174 35–49 years (35%), and 143 50–64 years (28%) (Box 4). In all, 214 respondents (43%) disagreed and 145 agreed (29%) with the proposition that seasonal chocolate figures were re-packaged and re-sold (Box 5).

Discussion

Our study explored the urban myth that unsold chocolate Easter Bunnies are re-wrapped and sold as chocolate Santa Clauses. Using advanced radiological imaging and the judgment of four independent radiology experts, we did not find evidence supporting this belief. While about 30% of respondents in our survey believed the myth, most patients and hospital personnel did not regard the consumption of expired chocolate a safety threat.

We cannot discuss here the evidence for the favourable physiological effects of consuming chocolate, especially dark chocolate (eg, anti-oxidative and anti-inflammatory properties), nor the adverse effects (eg, increased serum glucose levels, risks of diabetes and becoming overweight).[5] Readers must decide for themselves whether enjoying a piece of chocolate has a stimulating impact on their mood; this study was not designed to encourage or dissuade people from consuming chocolate. Hospitals proved to be suitable research environments for our survey study of the association between chocolate exposure and certain endpoints potentially relevant to health care professionals.[6]

Implications for clinicians and policymakers

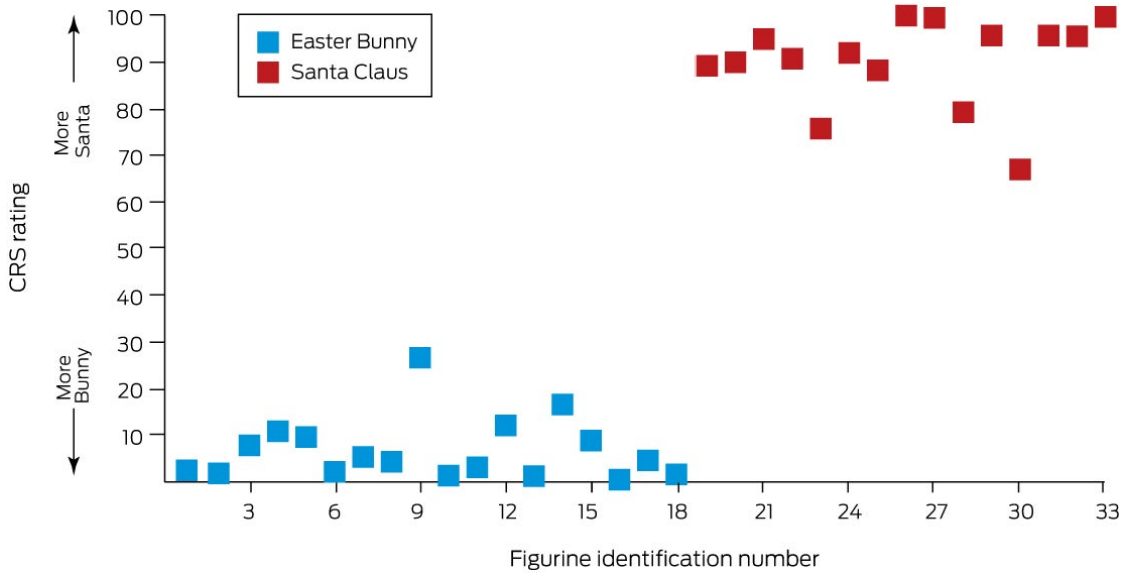
With 220 million chocolate Easter Bunnies and 151 million chocolate Santa Clauses produced in Germany during 2019 alone,[7] the confectionery industry would face a significant loss of trust and sales should doubts about the transparency of their manufacturing practices arise.[8] Dual processing of chocolate could increase the risk of contamination not only by pathogens, but also by industrial residuals. In 2016, one small plastic piece found in a chocolate bar led to the recall of products in 55 countries.[9] Further, the foil wrapping of chocolate figurines can pose a choking hazard,[10] and it is unclear whether re-packaging would increase this risk. As it has been estimated that manufacturing new chocolate figurines from recycled ones would increase production costs by about 30%,[11,12] it is more likely that leftover chocolate figurines are discarded rather than re-used.

2 Baseline measurements of seasonal chocolate figurines

Characteristic	Easter Bunny	Santa Claus
Eligible specimens	18	15
Manual measurements: mean (SD)		
Weight (g): labelled	89.1 (22.9)	90.0 (25.0)
Weight (g): weighed	94.4 (25.7)	92.9 (24.5)
Height (cm)	14.6 (3.5)	15.3 (2.8)
Width (cm)	6.6 (1.5)	6.5 (1.4)
Depth (cm)	5.4 (1.9)	3.9 (0.7)
Imaging* measurements: mean (SD)		
Height (cm)	14.9 (3.3)	15.0 (2.8)
Width (cm)	6.2 (1.3)	6.3 (1.0)
Depth (cm)	5.4 (1.9)	4.0 (0.7)
Layer thickness: floor (mm)	3.3 (2.1)	2.7 (0.7)
Layer thickness: top (mm)	8.9 (7.0)	5.3 (2.6)
Layer thickness: lateral wall (mm)	6.2 (1.8)	5.9 (1.4)

SD = standard deviation.
* Non-contrast whole body computed tomography. ◆

3 Mean contour resemblance scale (CRS) ratings by four expert radiology assessors of 18 Easter Bunnies and 15 Santa Clauses, based on computed tomography images



Limitations

Assessment of the outer and inner shapes of seasonal figurines is only one of many possible surrogate measures for detecting recycling. Re-use of chocolate from other sources might be detected by characteristic contaminants carried over from earlier packaging. Mineral oil hydrocarbons from cardboard are frequently found in chocolates in Advent calendars,[13] making them candidates for detecting illegitimate recycling of seasonal chocolate products. However, Easter Bunnies and Santa Clauses are typically covered by the same material (aluminium foil), making rewrapping a challenging analytic task. Advanced food chemical methods could assess the degree of degradation and the age of ingredients. While technically possible, the CRECHE group food chemist rated the effort, resources, and costs of such analyses excessive given the likelihood of meaningful scientific findings.

Our study was susceptible to several methodological shortcomings and restrictions. The choice of figurines was not entirely random, although shoppers were free to buy the Easter Bunny or Christmas Santa of their choice. Oversampling of common or premium brand products was, however, likely, thereby limiting the generalisability of our findings. The sample size for the experimental component of our study was rather small, but CRS ratings were homogenous and inter-rater reliability was excellent for WBCT assessments. This method proved to be both feasible and precise in depicting the structure of chocolate figurines, although determining the thickness of chocolate layers relied on manual assessment by a radiologist. Machine learning may one day assist WBCT, adding artificial intelligence to the screening of chocolate figurines during the holiday season.

Further, our study could provide evidence regarding the myth that chocolate Easter Bunnies are turned into Santa Clauses, but not regarding the converse myth that chocolate Santa Clauses are turned into Easter Bunnies. This would require another study and an issue of a leading journal dedicated to Easter.

4 Socio-demographic characteristics of GRINCH questionnaire survey participants

Characteristic	Site 1	Site 2	Total
Participants	439	63	502
Sex			
Women	247 (56%)	30 (48%)	277 (55%)
Men	168 (38%)	31 (49%)	199 (40%)
Diverse	7 (2%)	1 (2%)	8 (2%)
Missing data	17 (4%)	1 (2%)	18 (4%)
Age group (years)			
< 20	14 (3%)	1 (2%)	15 (3%)
20–34	83 (19%)	26 (41%)	109 (22%)
35–49	153 (35%)	21 (33%)	174 (35%)
50–64	130 (30%)	13 (21%)	143 (28%)
65–79	36 (8%)	1 (2%)	37 (7%)
> 79	7 (2%)	0	7 (1%)
Missing data	16 (4%)	1 (2%)	17 (3%)
Purpose of visit			
Patient	76 (17%)	26 (41%)	102 (20%)
Relative	33 (8%)	2 (3%)	35 (7%)
Other visitor	33 (8%)	1 (2%)	34 (7%)
Employee, medical	126 (29%)	16 (25%)	142 (28%)
Employee, non-medical	126 (29%)	15 (24%)	141 (28%)
Missing data	45 (10%)	3 (5%)	48 (10%)

5 Results of the GRINCH questionnaire survey (N = 502)

Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Cannot say	Missing response
I like to eat chocolate	39 (8%)	50 (10%)	47 (9%)	113 (22%)	247 (49%)	3 (0.6%)	3 (0.6%)
Chocolate Santa Clauses are re-packaged chocolate Easter Bunnies	139 (28%)	75 (15%)	80 (16%)	72 (14%)	73 (14%)	52 (10%)	11 (2%)
Expired chocolate is harmful to health	97 (19%)	156 (31%)	101 (20%)	59 (12%)	46 (9%)	37 (7%)	6 (1%)
Chocolate gifts should be checked for food safety in the hospital	150 (30%)	99 (20%)	80 (16%)	68 (14%)	78 (16%)	25 (5%)	2 (0.4%)
I once felt uncomfortable after eating expired chocolate	255 (51%)	83 (17%)	35 (7%)	44 (9%)	32 (6%)	51 (10%)	2 (0.4%)

Conclusion

The CRECHE study was the first scientific project, using advanced radiologic imaging, to investigate the urban myth that unsold chocolate Easter Bunnies are re-packaged as Santa Clauses for the subsequent Christmas season. Our radiological evidence did not support this myth. Chocolate Santa Claus figurines can be consumed in hospital settings without concern, with zero risk of food hygiene being compromised by re-used chocolate bodies.

Competing interests: All contributors have a conflict of interest, as they or their relatives are past or current consumers of chocolate figurines, although they have no preference for any brand investigated here.

Data sharing statement: All data are available upon request to the study investigators.

Acknowledgements: We thank the staff of both institutions and all volunteers for their efforts and willingness to provide anonymised data for this investigation. We also thank Stefan Müller-Lissner, head of the institutional review board (IRB) of the *Ärztekammer* Berlin, well as all IRB members, for their sense of humour, permission to include minors (ie, chocolate figurines produced during or before the year of the investigation) without informed consent, and their generosity in providing IRB approval at no cost. We also thank Melissa Leis-Schrage for proofreading and editing the manuscript. ■

Received 4 June 2021, accepted 20 October 2021

1 Nieburg O. No bunny scraps in our santas: German chocolate industry. *FoodNavigator*, updated 16 Apr 2013. https://www.foodnavigator.com/Article/2013/04/16/Chocolate-santas-made-from-Easter-bunnies-denials (viewed Oct 2021).

2 Craven PC, Mackel DC, Baine WB, et al. International outbreak of *Salmonella eastbourne* infection traced to contaminated chocolate. *Lancet* 1975; 1: 788–792.

3 Kooser A. Easter chocolates look kind of gross in 3D X-ray scans. *CNET*, 30 Mar 2018. https://www.cnet.com/news/easter-chocolates-look-gross-in-xray-computer-3d-scans (viewed Oct 2021).

4 Julious SA. Sample size of 12 per group rule of thumb for a pilot study. *Pharm Stat* 2005; 4: 287–291.

5 Veronese N, Demurtas J, Celotto S, et al. Is chocolate consumption associated with health outcomes? An umbrella review of systematic reviews and meta-analyses. *Clin Nutr* 2019; 38: 1101–1108.

6 Gajendragadkar PR, Moualed DJ, Nicolson PL, et al. The survival time of chocolates on hospital wards: covert observational study. *BMJ* 2013; 347: f7198.

7 Chocolate products in Germany. *Statista*, 2021. https://www.statista.com/study/62283/chocolate-products-in-germany (viewed Oct 2021).

8 Taylor K. Sales of the most hip chocolate brand are plunging after a scandal. *Business Insider India*, 20 Jan 2016. https://www.businessinsider.in/Sales-of-the-most-hip-chocolate-brand-are-plunging-after-a-scandal/articleshow/50647380.cms (viewed Oct 2021).

9 Sheahan M, Geller M. Plastic in Snickers bar prompts Mars recall in 55 countries. *Reuters*, 24 Feb 2016. https://www.reuters.com/article/us-mars-germany-recall-idUSKCN0VW1UD (viewed Oct 2021).

10 Hammett E. Eight steps to minimise the risk of your child choking this Easter. *First Aid for Life* 10 Mar 2021. https://firstaidforlife.org.uk/mini-egg-choking-danger (viewed Oct 2021).

11 What happens to the chocolate Santa after Christmas? *fairafric* (Germany), 18 Jan 2021. https://fairafric.com/en/what-happens-to-the-chocolate-santa-after-christmas (viewed Oct 2021).

12 Henri K. What happens to unsold holiday candy (and how long can you eat it)? *Today* (US), 19 Dec 2012. https://www.today.com/food/what-happens-unsold-holiday-candy-how-long-can-you-eat-1C7658778 (viewed Oct 2021).

13 Adventskalender mit Schokoladenfüllung. Mineralöl in der Schokolade. *Stiftung Warentest*, 26 Nov 2012. https://www.test.de/Adventskalender-mit-Schokoladenfuellung-Mineraloel-in-der-Schokolade-4471436-0 (viewed Oct 2021). ■

Supporting Information

Additional Supporting Information is included with the online version of this article.