

## Article

# The Iconisation of Yeast Spreads—Love Them or Hate Them

Frank Vriesekoop<sup>1,2,\*</sup>, Carolyn Russell<sup>3</sup>, Athina Tziboula-Clarke<sup>4</sup>, Céline Jan<sup>1</sup>, Marine Bois<sup>1</sup>,  
Stephanie Farley<sup>2</sup> and Allison McNamara<sup>2</sup>

- <sup>1</sup> Department of Food, Land and Agribusiness Management, Harper Adams University, Newport TF10 8NB, UK; celine.jan3@gmail.com (C.J.); marine.bois@etu.unilim.fr (M.B.)  
<sup>2</sup> School of Science, Psychology and Sport, Mount Helen Campus, Federation University Australia, Ballarat, VIC 3353, Australia; steph.a.farley@gmail.com (S.F.); amcnamara@live.com.au (A.M.)  
<sup>3</sup> School of Viticulture and Wine Science, Eastern Institute of Technology, Taradale, Napier 4112, New Zealand; crussell@eit.ac.nz  
<sup>4</sup> Division of Engineering and Food Sciences, Abertay University, Dundee DD1 1HG, UK; a.tziboula-clarke@abertay.ac.uk  
\* Correspondence: fvriesekoop@harper-adams.ac.uk

**Abstract:** The production of beer yields a number of by-product streams, with spent brewers' yeast being the second most abundant in volume. The high nutritional value of spent yeast has seen a large proportion of spent brewers' yeast being used for both food and feed purposes. One of the uses of spent brewers' yeast for human consumption has been the production of yeast spreads, which came onto the market in the early 20th century, first in the United Kingdom and shortly thereafter in the commonwealth dominions, especially Australia and New Zealand. In this research we investigated the national status of yeast spreads in the UK, Australia and New Zealand. We show that a brewery by-product such as spent brewers' yeast is more than a mere novel utilisation of a waste stream but have become inherently associated with national identities of these countries to such an extent that some brands have become iconicised. Furthermore, some yeast spread brands have become a symbol of (inter)national polarisation, purely based on its initial sensorial characterisation.

**Keywords:** spent yeast; Marmite; Vegemite; iconic; product recognition; national identity



**Citation:** Vriesekoop, F.; Russell, C.; Tziboula-Clarke, A.; Jan, C.; Bois, M.; Farley, S.; McNamara, A. The Iconisation of Yeast Spreads—Love Them or Hate Them. *Beverages* **2022**, *8*, 16. <https://doi.org/10.3390/beverages8010016>

Academic Editor: Dimitris P. Makris

Received: 13 February 2022

Accepted: 28 February 2022

Published: 7 March 2022

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



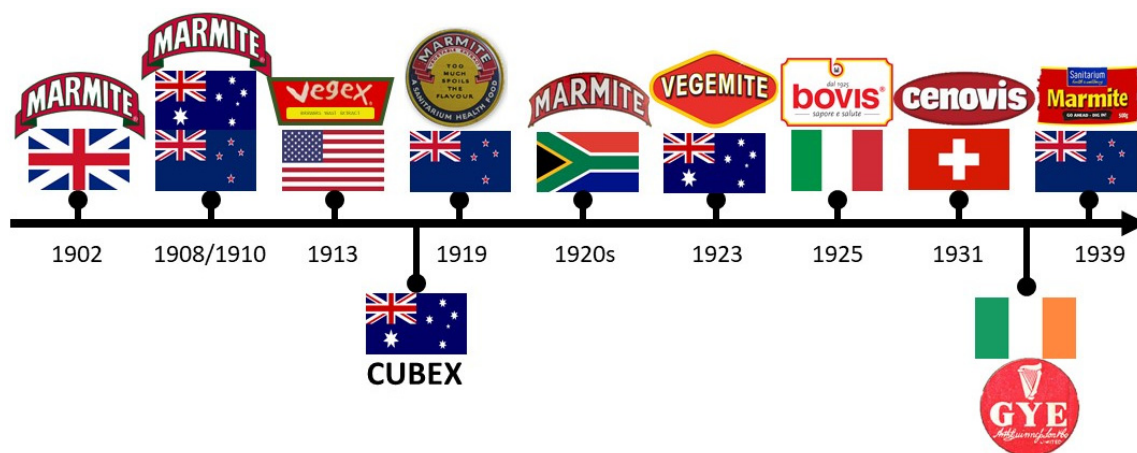
**Copyright:** © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

The production of beer generates a range of by-products, ranging from spent grain, spent yeast, spent hops/hot trub [1], and waste and unsold beers [2], with spent brewer's grain being the most abundant by-product [3]. Spent brewer's yeast is the second largest by-product generated by the brewing industry. The term "spent brewer's yeast" is used to describe yeast that is surplus to the brewer's needs or is no longer needed in the brewing process. There is an ongoing excess of spent brewer's yeast coming from the brewing industry. This is because the beer fermentation process generates approximately four to five times the amount of yeast in excess of the yeast required to start the fermentation [3]. In most breweries, a considerable amount of this yeast is reused to start a subsequent fermentation, which can be as extensive as 20 cycles, or as limited as three to six cycles [4]. Nevertheless, a considerable quantity of the yeast generated is surplus to the brewer's needs, even though it is otherwise suited for re-pitching in the beer production process [5]. The limitation on continued reuse stems from either risks associated with microbial contamination that can become more significant as the yeast reproduces through many generations, or from "exhaustion" of the yeast culture itself—both of which affect the quality of the resultant beer and accordingly require the yeast culture to be discarded at some point. Furthermore, some non-reusable yeast is generated during beer maturation in the post-fermentation stages, including yeast obtained from the bottoms of maturation tanks. The brewer has no need for this excess or "worn-out" yeast and has sought an avenue to dispose of it. If the

brewer produces significant quantities of spent brewer's yeast, this surplus by-product can be sold and used for other purposes [1,3].

While the concept of using spent brewer's yeast for human consumption was a German inspired process, the bulk of products and processes to produce them were established in English speaking countries [2,6]. In 1902 the first Marmite plant was established in Burton up on Trent (UK), which saw a rapid expansion of production across the British Commonwealth into Australia, New Zealand, and southern Africa. In 1908 an antipodean Marmite plant was established in Australia, with distribution in Australia (1908) and New Zealand (1910). The production of the antipodean Marmite moved to New Zealand in 1919 (Figure 1). Sometime in the 1920s, Marmite production also commenced in South Africa. In 1913 a similar product (Vegex) came on to the market in the USA [3]. Following the local production of a yeast spread in Australia, the newly formed brewing conglomerate—Carlton and United Breweries (CUB)—launched a yeast spread under the trade name Cubex in 1918 [7] (Symons, 1987). Despite Cubex's removal from the market in 1933, CUB retains its trademark. A rival brand to Marmite (Vegemite) was launched in Australia in 1923 by the Fred Walker Cheese Co. [8]. By this time the notion of utilising spent brewer's yeast as a potentially healthy product also triggered the production of yeast spreads in other countries. A separate brand (Bovis) launched in Italy in 1925; while Cenovis started in Switzerland in 1931. The Guinness brewery launched their own "Guinness Yeast Extract" in 1936, which remained commercially available until 1968. New products have come on to the market in more recent years. All these products, apart from Cubex and Guinness Yeast Extract, are still on the market and are predominantly produced from spent brewer's yeast [3].



**Figure 1.** Timeline of the early development of yeast spreads indicating the brand, the year of commercial launch, and the country where the development/launch occurred, indicated by the respective country flag. All brands listed above the timeline are still currently still commercially available, those listed below the timeline are no longer commercially available. Timeline not to scale.

The production of yeast spreads from brewer's spent yeast commences with the selection of an appropriate quality of spent brewer's yeast that is substantially free of bacterial contamination and extraneous materials such as filter aids and excessive hops flavours and aromas. The yeast extract processing plants require a reasonably consistent supply of spent brewer's yeast in terms of dry weight, residual sugar and ethanol. Some producers of yeast extract allow the yeast to grow on a sucrose substrate in order to achieve sufficient supply of raw spent yeast and as a mean to reduce residual hops components [3]. The typical production is as follows: the spent yeast slurry is heated and salt and enzymes are added after which the hydrolysis process proceeds at 63 °C during which yeast enzymes facilitate the hydrolysis of various yeast cell components. The additional enzymes permit particular hydrolytic reactions to be emphasised in order to speed up and steer the hydrolytic process towards specific quality parameters. Following the hydrolysis process much of the yeast

cell wall particulates are removed. The remaining liquid is concentrated by means of a rotary drum filter and multi-stage vacuum evaporators after which spices can be added to finish off the flavour profile [9]. This produces a relatively fluid product whilst the pastier yeast extracts tend have yeast cell wall materials added back in to achieve the desired consistency required for a spreadable product [3].

The two main brands, Marmite and Vegemite, hold a special place in the hearts of people who grew up with them, they either ‘love it’ or ‘hate it’. In many instances this liking of the product seems due to the fact that people grew up with the product during their childhood when yeast extract would have been unceremoniously presented (particularly at breakfast) as a healthy source of nutrients and particularly of vitamins. Essentially, the ultimate source of goodness! This has been strengthened by the fact that the national armies of those nations included these products in the soldiers’ rations during times of armed conflict in the early- to mid-1900s. Why question the nutritional goodness on what ‘our proud army’ marches on? Furthermore, nutritional evidence had shown that people suffering anaemia and other vitamin related deficiencies could be healed by the consumption of a spread made from spent brewer’s yeast [10–16]. More recently yeast spreads have shown to have a positive effect on alleviating anxiety and stress in people who regularly consume them [3,17]. On the other hand, the dislike (hate) for the products appears to be entirely sensorial [18,19] and often linked to their salty and yeasty flavour [20].

Apart from the “Love it or Hate it” sloganism within each single country where yeast spreads are being produced, there also seem to be a national rivalry which is readily exploited by the individual producers’ marketing departments in a tongue-in-cheek manner [21–25]. In this study we attempt to uncover impact of the sloganism and national rivalry on the ability of people within the United Kingdom, Australia and New Zealand to recognise their own national brand by sight of the packaged product and then to uncover whether the brand itself or the product is the item they associate their sloganism and national rivalry with.

## 2. Materials and Methods

### 2.1. Yeast Spreads

Commercially available branded yeast spreads (Marmite (UK), Burton upon Trent, United Kingdom, and Marmite (NZ), Christchurch, New Zealand, and Vegemite, Melbourne, Victoria, Australia, plus Cenovis, Rheinfelden, Switzerland and Promite, Berkeley Vale, NSW, Australia) were purchased in local supermarkets and shared between the research groups. The two Marmites and the Vegemite were included in this study as they are the direct descendant yeast spread brands from the first commercially available yeast spread. Cenovis was included as a long-standing yeast spread that was unlikely to be known by the respondents in the three countries in this study. Promite was included as a convenient commercially available yeast spread that is made from yeast, but not spent brewers’ yeast.

### 2.2. Questionnaire Design

Two different questionnaires were used in this study. One quick-pole questionnaire was used to ascertain the most readily recalled national food and beverage brands in each of the three countries, while a second questionnaire was used to gauge people knowledge about the three national yeast spreads.

#### 2.2.1. Top 10 of National Food Brands

The data obtained from this questionnaire was used to create a “Top 10” of readily recalled national food and beverage brands. These surveys were distributed via a range of national contact lists and yielded 412 responses from the UK, 313 responses from Australia and 304 responses from New Zealand (Table 1).

**Table 1.** Number of participants and sensory tests carried out within this research in three different countries.

| Non-Sensory Tests     | United Kingdom | Australia | New Zealand |
|-----------------------|----------------|-----------|-------------|
| Top-10                | 412            | 313       | 305         |
| Recognition challenge | 702            | 249       | 222         |
| Sensory tests         |                |           |             |
| Triangle participants | 72             | 70        | 35          |
| Triangle tests        | 288            | 280       | 140         |
| Ranking participants  | 168            | 92        | 70          |

### 2.2.2. Brand Recognition Challenge

In each of the three countries researchers undertook street research where they randomly approached passers-by in a range of settings (shopping streets in towns and cities, public events, etc.). The individuals approached were asked whether they recognised the jar of the national yeast spread shown to them by the researcher. If they indicated that they recognised the product, they were asked whether they “love” or “hate” the product. Regardless of the response, the respondents were then asked whether they believed that the product was an ‘iconic product’.

The individuals were then presented with pictures of four other yeast spread brands. In the UK, those four brands were Promite (an Australian vegetable and yeast spread), Cenovis (a swiss yeast spread), Vegemite, and the New Zealand Marmite brand. In Australia, those four brands were Promite, Cenovis, and both the New Zealand and UK Marmite brands. In New Zealand those four brands were Promite, Cenovis, Vegemite, and the UK Marmite brand. People were asked whether were: (1) aware of these other brands; (2) had consumed any of these brands; and if they did, (3) their perception of those four other yeast spread brands.

### 2.3. Sensory Analysis

Those respondents who indicated that they ‘loved’ the national yeast spread brand and believed that brand to be ‘iconic’ were invited to a sensory session in which they were (i) asked to tell the difference between the national brand and any one or two of the other brands in a blind triangle taste test, and (ii) a ranking of all five yeast spreads (thinly spread on water crackers) based on sight, smell and taste. Since the initial part of the research was carried out by randomly approaching passers-by in a range of settings (shopping streets in towns and cities, public events, etc.), the sensory analysis was also carried out in a range of different settings. In an attempt to standardise the sensory settings, the sensory participants were provided with a sheltered area where they could carry out their sensory tests undisturbed while seated. In this study, all sensory participants were untrained passers-by with, in most instances, different participants for different tests (Table 1). The smallest number of sensory participants were 35 in New Zealand for the triangle test, however that resulted in a total of 140 triangle tests being completed in New Zealand (Table 1). The largest number of sensory participants were 168 in the UK for the ranking test. These numbers are within the range recommended untrained sensory assessors [26]. In both instances, triangle tests and the ranking tests, we provided a quiet place to sit down for the sensory participants. This was away from any major distractions (noise, odours, draughts, etc.) and away from direct sight from other passers-by so that people could focus on their sensory tasks.

#### 2.3.1. Triangle Taste Testing

The triangle taste test is a basic discrimination test in which the tester is presented with three similar products of which two are identical and one is different, and the tester will be tasked to indicate the one sample that is different [27]. In our study respondents who indicated that they ‘loved’ their national yeast spread were presented with four sets of three

water crackers. Each set contained two water crackers with a thin layer of the national yeast spread, and one water cracker with one of the 'other' yeast spreads. The participants were presented with one set of three spreaded water crackers at the time, while all yeast spread brands were assessed an equal number of times but presented to the sensory participants in a random order. In each instance, the samples were presented to the participant on a white plate with each sample indicated with a random 3-digit code. Plain water crackers and water were made available during the triangle testing.

### 2.3.2. Ranking Test

In sensory evaluation the ranking test represents a simple method in which multiple products can be presented simultaneous and does not require an external frame of reference [26]. In our study respondents who indicated that they 'loved' their national yeast spread were presented with a set of five water crackers with a thin layer of each of the five yeast spreads (Marmite (UK), Marmite (NZ), Vegemite, Promite, Cenovis). The samples were presented to the participant on a white plate with each sample indicated with a random 3-digit code. The sensory participants were instructed to first rank the five products entirely based on sight, i.e., the 'look' of the product (darkness, shininess, etc.). The participants were then instructed to rank the yeast spreads based on smell. Only after the participants had completed the olfactory component of the sensory session were participants asked to rank the yeast spreads based on taste. Participants were asked not to award the same ranking score to more than one sample/attribute within a set. Plain water crackers and water were made available during the ranking testing.

### 2.4. Statistical Analysis

In the ranking tests, the data was analysed using the nonparametric (distribution-free) Friedman ranking test [28]. Chi-square tests for independence were used to tests whether the distribution of responses to categorical statements/questions differed from each other. While statistical tables were used to determine the statistical significance among the triangle taste test data sets [29].

## 3. Results

### 3.1. Top 10 of National Food Brands

In order to ascertain on whether or not the three yeast spread brands are readily identified as 'important' brands in each of the three countries, we conducted a survey pole in which we asked people to list the first 10 national food and beverage brands that came to mind. Among the 313 Australian respondents 317 brands were mentioned in which Vegemite ranked 1st (Table 2). Among the 412 UK respondents 425 brands were mentioned in which Marmite (UK) ranked 7th. Among the 222 New Zealand respondents 308 brands were mentioned in which Marmite (NZ) ranked 10th. In each of the three countries the national yeast spread brands appeared in the top-10 of readily identified food brands (Table 2), indicating that the three yeast spread brands have a high degree of familiarity within their respective home-countries.

### 3.2. Recognition and "Iconic" Status of National Yeast Spread Brands

When approached by the researchers, all passers-by recognised the jar of yeast spread shown to them. In the UK, 44% of passers-by indicated that they "loved" the product, while that proportion was 43% and 71% in New Zealand and Australia, respectively (Table 3),  $X^2 = df 4, n = 1173, CV = 84.91, p < 0.001$ . When asked whether the brand was "iconic" in relation to their country, 99% of Australians answered "yes", 84% of New Zealanders answered "yes" and 61% of Brits answered "yes".



**Table 2.** Ranking of national food and beverage brands as indicated by consumers in the UK, Australia and New Zealand.

| Ranking | United Kingdom<br>(n = 412) | Australia<br>(n = 313) | New Zealand<br>(n = 305) |
|---------|-----------------------------|------------------------|--------------------------|
| 1       | Heinz                       | Vegemite               | Watties                  |
| 2       | Cadbury                     | Victoria Bitter        | Anchor                   |
| 3       | Hovis                       | Arnott's               | TipTop (bread)           |
| 4       | Kellogs                     | Dick Smith's           | L&P                      |
| 5       | Walkers                     | Weet-Bix               | Whiakers                 |
| 6       | Warburtons                  | SPC_Ardmona            | Sanitarium               |
| 7       | Marmite (UK)                | Cadbury                | Tui                      |
| 8       | McVitie's                   | Coopers                | Griffin's                |
| 9       | HP sauce                    | Rosella                | Pam's                    |
| 10      | Robinsons                   | TimTam                 | Marmite (NZ)             |
| 11      | Tetley                      | Cottee's               | Mainland                 |
| 12      | Walkers crisps              | Fosters                | Cadbury                  |
| 13      | Birds eye                   | Uncle Toby             | TipTop (icecream)        |
| 14      | PG Tips                     | XXXX beer              | Vogels                   |
| 15      | Yorkshire Tea               | Milo                   | Bluebird                 |
| 16      | Coca Cola                   | Four'nTwenty           | Hubbards Cereals         |
| 17      | Coleman                     | Golden Circle          | Speight                  |
| 18      | Branston Pickles            | TipTop (bread)         | Charlies Juices          |
| 19      | Cathedral City              | Bundaberg (rum)        | Weet-Bix                 |
| 20      | Twining's                   | Beerenburgh            | Pascal Pineapple Lumps   |

**Table 3.** Recognition and "iconic" status of national yeast spread brands.

|  | United Kingdom<br>n = 702 | Australia<br>n = 249 | New Zealand<br>n = 222 |
|--|---------------------------|----------------------|------------------------|
| Recognition of national yeast spread brand | 100%                      | 100%                 | 100%                   |
| "love" the product                         | 44%                       | 71%                  | 43%                    |
| "hate" the product                         | 28%                       | 5%                   | 19%                    |
| Neither "love" or "hate"                   | 28%                       | 24%                  | 38%                    |
| Assigns iconic status to brand             | 61%                       | 99%                  | 84%                    |

### 3.3. Awareness of Other (National) Yeast Spreads Brands

All participants were asked whether they were aware of a number of other yeast spread brands. In the first instance this was carried out by showing the passers-by pictures of four other yeast spreads. In the UK nearly 72% of people recognised Vegemite and 27.4% of the passers-by had consumed Vegemite (Table 4). About 11% of Brits thought that Vegemite tasted nicer than the UK Marmite, while 23% disliked the taste of Vegemite, the remaining 2/3 of Brits thought that Vegemite either the same or just "different, but OK". Among the Brits, only a small proportion of people thought that the New Zealand Marmite

tasted nicer than the UK Marmite, while more than half disliked the taste of the New Zealand Marmite. Only a very small proportion of Brits indicated that they ever consumed Promite, and those that did overwhelmingly indicated that Promite taste “different, but OK”. None of the Brits ever tasted the Swiss Cenovis (Table 4).

**Table 4.** Awareness and consumption of other (national) yeast spreads brands in the United Kingdom ( $n = 702$ ).

| Other Brands               |                   | Vegemite | Marmite (NZ) | Promite | Cenovis |
|----------------------------|-------------------|----------|--------------|---------|---------|
| Aware of *                 |                   | 71.7%    | 6.4%         | 3.1%    | 0.9%    |
| Have previously consumed * |                   | 27.4%    | 2.7%         | 2.1%    | 0%      |
| Sensory recall **          | Nicer             | 11%      | 4%           | 14%     | 0%      |
|                            | Same              | 18%      | 30%          | 19%     | 0%      |
|                            | Different, but OK | 48%      | 15%          | 67%     | 0%      |
|                            | Horrible          | 23%      | 51%          | 0%      | 0%      |

\* as a proportion of the total sampled population ( $n = 702$ ), \*\* as a proportion of the population who indicated that they consumed the other spreads.

In Australia, most passers-by were aware of Promite (61%) and both the New Zealand and British Marmite at 40% and 26.5%, respectively (Table 5). Nearly a quarter of Australians indicated that they had previously consumed Promite, closely followed by the New Zealand Marmite at 21.3% and the UK Marmite at 14.4%. None of the passers-by in Australia had ever consumed Cenovis. Roughly  $1/3$  of Australians indicated that they disliked Marmite, while almost  $2/3$  indicated that they disliked Promite. A small proportion of Australians indicated that liked Promite better than Vegemite (6%), while nearly  $1/5$  of Australians indicated that UK Marmite tasted better than Vegemite. The remainder was relatively indifferent to their appreciation of either Marmite or Promite based on their past-experience with those brands (Table 5).

**Table 5.** Awareness and consumption of other (national) yeast spreads brands in Australia ( $n = 249$ ).

| Other Brands               |                   | Marmite (UK) | Marmite (NZ) | Promite | Cenovis |
|----------------------------|-------------------|--------------|--------------|---------|---------|
| Aware of *                 |                   | 26.5%        | 40.2%        | 61.0%   | 3.2%    |
| Have previously consumed * |                   | 14.4%        | 21.3%        | 24.9%   | 0%      |
| Sensory recall **          | Nicer             | 19%          | 8%           | 6%      | 0%      |
|                            | Same              | 0%           | 15%          | 8%      | 0%      |
|                            | Different, but OK | 47%          | 45%          | 24%     | 0%      |
|                            | Horrible          | 34%          | 32%          | 62%     | 0%      |

\* as a proportion of the total sampled population ( $n = 249$ ), \*\* as a proportion of the population who indicated that they consumed the other spreads.

In New Zealand, the vast majority passers-by were aware of Vegemite (91%) and both the British Marmite and Promite at 38% and 20%, respectively (Table 6). A large proportion of New Zealanders (85%) indicated that they had previously consumed Vegemite, while approximately 30% of New Zealanders indicated that they had consumed the UK Marmite at 14.4%, followed by 11% who indicated that they had consumed Promite. None of the passers-by in Australia had ever consumed Cenovis. Between  $1/3$  and a quarter of New Zealanders indicated that they liked the other brands better compared to the New Zealand Marmite (Table 6), while between 40 and 50% of New Zealanders were indifferent about what they could recall about the taste of Vegemite, UK Marmite and Promite.

**Table 6.** Awareness and consumption of other (national) yeast spreads brands in New Zealand ( $n = 222$ ).

| Other Brands               |                   | Vegemite | Marmite (UK) | Promite | Cenovis |
|----------------------------|-------------------|----------|--------------|---------|---------|
| Aware of *                 |                   | 90.5%    | 37.8%        | 20.3%   | 0%      |
| Have previously consumed * |                   | 84.7%    | 29.3%        | 10.8%   | 0%      |
| Sensory recall **          | Nicer             | 32%      | 30%          | 25%     | 0%      |
|                            | Same              | 18%      | 36%          | 13%     | 0%      |
|                            | Different, but OK | 20%      | 17%          | 29%     | 0%      |
|                            | Horrible          | 30%      | 17%          | 33%     | 0%      |

\* as a proportion of the total sampled population ( $n = 222$ ), \*\* as a proportion of the population who indicated that they consumed the other spreads.

### 3.4. Impromptu Sensory Evaluation of Yeast Spreads in the UK, New Zealand and Australia, Aka “the Yeast Spread Identity Parade”

Further to being asked whether the passers-by were aware of other national yeast spreads and their past recognition of consuming those yeast spreads, we asked the same passers-by whether they thought they could tell the difference between their national yeast spread brand and any of the other yeast spreads. We challenged the passers-by with either a triangle test or a ranking test. In both instances, triangle tests and the ranking tests, we provided a quiet place to sit down for the sensory participants.

#### 3.4.1. Impromptu Triangle Testing of Yeast Spreads

All participants were challenged to a triangle test in which they were presented with two water crackers with their own national yeast spread thinly spread onto the crackers and one other water cracker with one of the other yeast spreads (also thinly spread). In all three countries the vast majority of people were able to correctly identify the odd one out (Table 7). It appears that Australian passers-by were better at identifying the odd one out, followed by the New Zealander passers-by and the British passers-by. However, the fact that the vast majority of people could correctly identify the odd yeast spread out in a triangle test merely indicates that people could ‘tell the difference’ [29] between different yeast spreads.

**Table 7.** Ability to correctly identify the “odd one out” in an impromptu sensory triangle test.

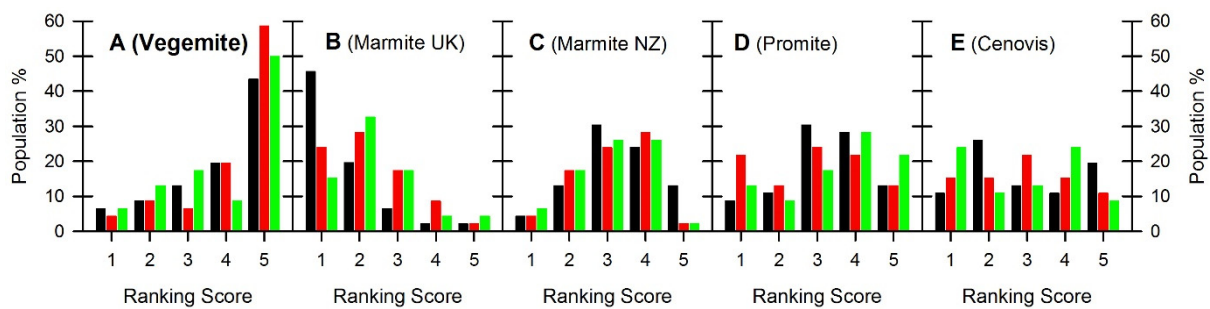
| Other Brands   | Vegemite | Marmite (UK) | Marmite (NZ) | Cenovis |
|----------------|----------|--------------|--------------|---------|
| United Kingdom | 82% *    | NA **        | 87% *        | 75% *   |
| Australia      | NA **    | 91% *        | 80% *        | 91% *   |
| New Zealand    | 80% *    | 83% *        | NA **        | 91% *   |

\*  $p = 0.01$  [29], \*\* Not Applicable because the product was the control in that country.

#### 3.4.2. Impromptu Sensory Ranking of Yeast Spreads

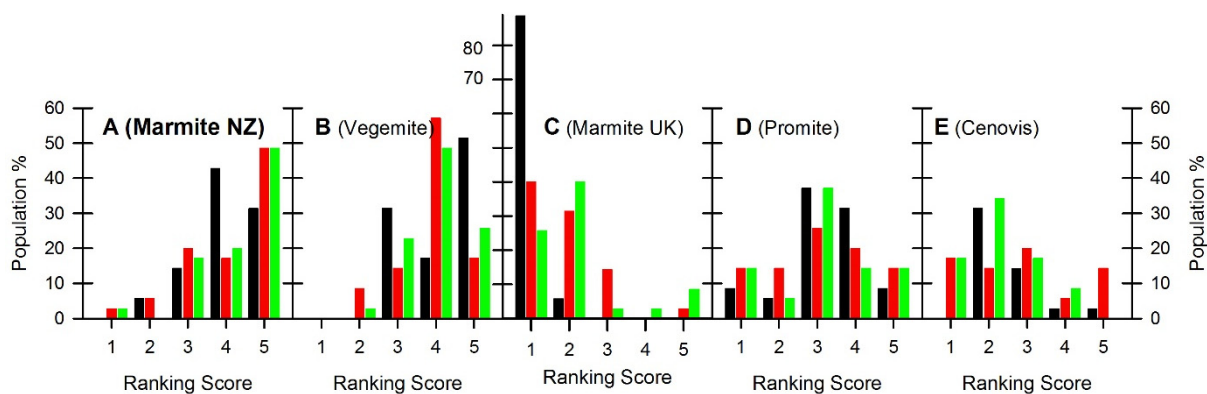
When presented with five water crackers that each had a thin layer of one of each of the yeast spread brands applied to it, the Australian passers-by scored Vegemite highest in terms of sight, smell and taste (Figure 2A). The British Marmite (UK) scored the lowest in Australia with 65% of Australians disliking the ‘look’ of UK Marmite, 52% disliking the smell and 48% disliking the taste. There was a much greater appreciation for the New Zealand Marmite, however, the New Zealand Marmite hardly ever scored the highest score for smell or taste (Figure 2C). Overall, the Australian passers-by were relatively speaking indifferent about either Promote or Cenovis (Figure 2D,E).





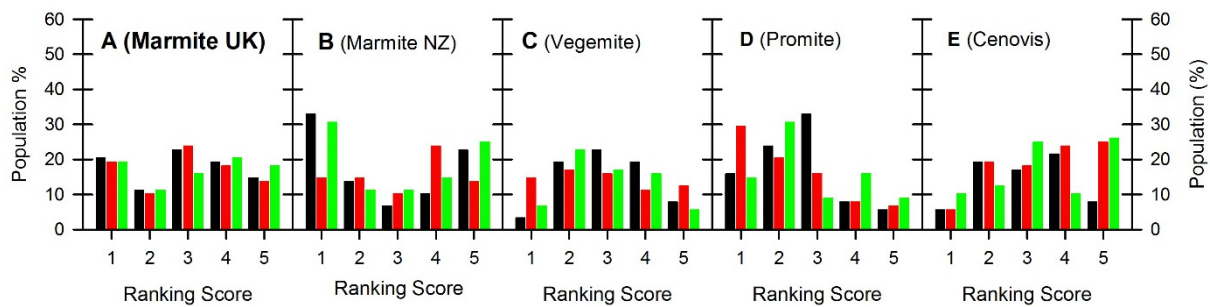
**Figure 2.** Ranking of yeast spreads in impromptu sensory sessions in Australia ( $n = 92$ ). (A) ranking received by Vegemite (in bold); (B) rankings received by the UK Marmite; (C) rankings received by the New Zealand Marmite; (D) ranking received by Promite; and (E) rankings received by Cenovis. Rankings ranged from 1 to 5 as from low to high. Black bars represent the sensory perception based on sight only. Red bars represent the sensory perception based on smell only. Green bars represent the sensory perception based on taste only. Friedman ranking tests for all three attributes returned  $p < 0.01$ .

Similarly, when presented with five water crackers that each had a thin layer of one of each of the yeast spread brands applied to it, the New Zealand passers-by scored Their own national Marmite highest in terms of smell and taste (Figure 3A). However, the New Zealand passers-by had a greater liking for the sight of Vegemite (compare Figure 3A,B). Overall, the liking for New Zealand Marmite and Vegemite in terms of sight, smell and taste was very similar in New Zealand. Contrary to that, the New Zealand passers-by had a very strong dislike for British Marmite with the sight of British Marmite scoring extremely low (Figure 3C). Similar to the Australians, the New Zealand passers-by were indifferent about either Promote or Cenovis (Figure 3D,E).



**Figure 3.** Ranking of yeast spreads in an impromptu sensory session in New Zealand ( $n = 70$ ). (A) ranking received by the New Zealand Marmite (in bold); (B) rankings received by Vegemite; (C) rankings received by the UK Marmite; (D) ranking received by Promite; and (E) rankings received by Cenovis. Rankings ranged from 1 to 5 as from low to high. Black bars represent the sensory perception based on sight only. Red bars represent the sensory perception based on smell only. Green bars represent the sensory perception based on taste only. Friedman ranking tests for all three attributes returned  $p < 0.01$ .

In contrast with the Australian passers-by and the New Zealand passers-by, the British passers-by showed no ability to rank their own national yeast spread prominently high when presented with five water crackers that each had a thin layer of one of each of the yeast spread brands applied to it (Figure 4A–E). Based on sight and taste there was some dislike for the New Zealand Marmite, however, overall the British passers-by were relatively indifferent about all five yeast spreads.



**Figure 4.** Ranking of yeast spreads in an impromptu sensory session in the United Kingdom ( $n = 168$ ). (A) ranking received by the UK Marmite (in bold); (B) rankings received by the New Zealand Marmite; (C) rankings received by Vegemite; (D) ranking received by Promite; and (E) rankings received by Cenovis. Rankings ranged from 1 to 5 as from low to high. Black bars represent the sensory perception based on sight only. Red bars represent the sensory perception based on smell only. Green bars represent the sensory perception based on taste only. Friedman ranking tests for all three attributes returned  $p < 0.01$ .

## 4. Discussion

### 4.1. Brand Awareness

Both the British and New Zealand passers-by had a high awareness of the Australian Vegemite brand. This is probably due to the fact that Vegemite is readily available in both the British and New Zealand supermarkets. This also translates into an elevated past-consumption rate with 85% and 26% in New Zealand and the UK, respectively. The lack of immediate availability of the brands in the UK probably accounts for the very low past consumption of Promite and NZ Marmite, let alone the nil past consumption of the Swiss Cenovis. The historical imperialistic influence of the United Kingdom over Australia and New Zealand [30] and high immigration from the UK to both Australian and New Zealand [31,32] probably accounts for high awareness of the British Marmite in both Australia and New Zealand, despite the absence of the brand on the supermarket shelves in the two countries. This also translated in a relatively high past-consumption of the British Marmite in both countries.

### 4.2. Brand Iconisation

As shown earlier on, all passers-by in the United Kingdom, Australia and New Zealand readily recognised their national yeast spread brand by sight of the packaged product. Ninety-nine percent of Australians assigned an iconic status of Vegemite. Based on the Merriam-Webster dictionary, the term “icon” can be interpreted as: “an object of veneration” or “pictorial representation” (merriam-webster.com, accessed on 6 June 2021); while the Collins dictionary defines “icon” as a countable noun that “describes something as a symbol of a particular thing”, *viz* country (collinsdictionary.com, accessed on 6 June 2021). Among the New Zealanders and the Brits their national yeast spreads were perceived as iconic by 84 and 61% of the passers-by, respectively. In a sense, these national yeast spread brands could be caricatured as shown in Figure 5.

Inversely linked to the level of iconisation of the national yeast spreads is also the degree of dislike (hate) for the national yeast spreads in the three countries—the higher the level of iconisation, the lower the ‘hate’ for the product. It is likely that the New Zealand ‘love’ for their own national yeast spread is not necessarily in line with the national iconisation of the New Zealand Marmite, is due to the fact that the Australian yeast spread Vegemite scores quite high in the appreciation of the New Zealanders (see Figure 2 and Table 6). Despite most people being able to tell the difference between different yeast spreads, the sensory ranking of a range of yeast spreads revealed that the New Zealand passers-by ranked their own national product as most favourable.



**Figure 5.** Iconisation of national yeast spreads. Australian Vegemite morphed with a kangaroo and a cork-slouch hat. New Zealand Marmite morphed with a kiwi bird and a slice of kiwi in its beak. British Marmite wearing a British Queen’s guard uniform represented by black pants, red tunic and bearskins (hat). Artwork by Ariëlle Vriesekoop-Beswick and Frank Vriesekoop.

#### 4.3. Yeast Spread as a Symbol of National Identity

The question remains on whether the brand is more important than the product itself. If a brand is so highly placed on a pedestal, in for instance Australia where (1) everyone recognises the product’s packaging by sight and (2) 99% of people indicate that Vegemite is iconic and (3) 71% of people ‘love’ the product and only 5% indicate that they ‘hate’ (dislike) the product, it might well be that the iconised brand and the iconised product are the same thing. Similar to the New Zealanders, the Australians too ranked their own national product as most favourable. As such a brand/product like Vegemite has become a national identity. Vegemite as a symbol of national identity has been proposed before [8,33,34]. Brien [34] pointed out that Vegemite has a significant history as an object of study, mass media and popular interest. In popular Australian culture Vegemite has on numerous occasions been portrait as a national symbol as in John Williamson’s “True Blue”<sup>1</sup> and “Give me a home among the gum trees”<sup>2</sup>. Much earlier Alan Weekes wrote the TV Commercial “Happy little Vegemites”<sup>3</sup> where the jingle has become engrained in Australian culture. These three examples of evidence of Australian national identity linked to Vegemite in songs have been inward focussed and helped to enforce the pride and national identity for Vegemite by Australians. The same is true for Men at Work’s “Down Under”<sup>4</sup>, however, that song is internationally recognised as the “Vegemite sandwich” song.

While the Australian Vegemite is a strong example of a yeast spread being the flag bearer of the national identity, with the New Zealand Marmite being a distant second, only a sporadic notion of national pride/identity has been observed with regards to the British Marmite.

#### 4.4. Yeast Spread as Symbol of (National) Polarisation

On the other hand, a product such as the UK Marmite, where (1) 61% of Brits assign an iconic status to Marmite and (2) 44% of Brits “love” the product with 28% of people ‘hating’ (disliking) the product. Based purely on non-sensory perceptions this indicates that the Brits are the most polarised in their opinions of their national yeast spread—Marmite. As mentioned before most people were able to tell the difference between different yeast spreads, however, during the sensory ranking of a range of yeast spreads in the UK the passers-by were relatively indifferent in their ranking of the five yeast spreads. This could be interpreted as meaning that for most Brits the product itself is not overly important, but a polarised view with regards to the brand is important. The notion that Marmite (UK) not being overly important can be further endorsed by the fact that all major supermarkets

in the United Kingdom stock their own in-house brand of a yeast spread (author's own observations). Alternatively, the polarised view with regards to the brand Marmite is often encountered in popular culture and mass media. The "you either love it or hate it" slogan was conjured up by Flintham and McLeod in 1996 while working for the Boase Massimi Pollitt-Doyle Dane Bernach (BMP DDB) advertising agency [35]. The tagline "love it or hate it" has now turned into a truism so powerful that the words "like Marmite" are now regularly used to describe anything divisive. This divisive notion was exaggerated in an advertising spoof to the 2010 elections in the United Kingdom, fittingly referred to as The Marmite Election [6]. In the Marmite Election, Marmite's proprietors ran a fictitious televised election campaign of their own, between imaginary 'Love' and 'Hate' parties. Wadlow [6] speculated that either in response or in retaliation for being identified with the Hate Party, the British National Party was planning of transmit their party election broadcast in which the party leader would address the audience against a backdrop of a large image of a jar of Marmite. The divisive notion of Marmite has percolated into real-life UK politics too. In the UK the term "Marmite Politics" has been used to describe Brexit, two-party politics and issues related to immigration [36], but also to indicate divisive flip-flopping by individual politicians [37].

While in Australia, Vegemite has been incorporated into song that celebrate national identities, in the UK the mentioning of Marmite in songs is typically associated with which side of a divide people associate themselves with (Billy Bragg, 2002 "England, Half English"<sup>5</sup>; Andy Bown, 2011 "Tick my box"<sup>6</sup>; Wiley, 2020 "Free Spirit"<sup>7</sup>).

The concept of a hate/love polarisation that is so obviously present in the British Marmite is an uncommon phenomenon for the New Zealand Marmite or the Australian Vegemite. For Vegemite, this is quite clear from our data where we found that only a very small proportion (5%) of the Australian population declared a dislike for the product (Table 3), while in New Zealand the more telling part is the observation that a large proportion of the population is relatively indifferent to the polarisation notion of 'love vs. hate'.

#### 4.5. Marmite vs. Vegemite Rivalry

Apart from the national status each of the yeast spreads hold within their own national borders, a rivalry between the three yeast spread brands does exist.

For instance, during the first test of the 2019 Ashes tournament (cricket) free jars of Marmite were handed out to attending Australians in order to prove it (*viz* Marmite) is better than Vegemite, in a parallelly spoof to the British-Australian rivalry on the cricket pitch. This specific occurrence of rivalry found its roots in the 2018 ball tempering by an Australian bowler [38]. On 9 August 2019 the Australian Vegemite took out a full-page, tongue-in-cheek advert in the Daily Mirror to celebrate Australia's victory in the First Test in order to take some cheeky digs at the Brits [23]. On 10 August 2019 British Marmite retaliated with a similar tongue-in-cheek, full-page advert in the Daily Mirror stating "Dear Vegemite, we might not taste like Australia, but love it or hate it, we won't be tampering with it—see you at the home of cricket" [24].

Apart from the marketing-based rivalry between the two brands, a large number of comparative appreciations/condemnations of the various brands can be found on a simple internet search. Most of these comparative insights appear to be between Vegemite and the British Marmite, but to a lesser extend also between Vegemite and the New Zealand Marmite, and between the two independent Marmites. Interestingly, most of these comparative insights are about the product itself rather than the brand associated with the products.

#### 4.6. About the Root Cause of the Iconic Status of Yeast Spreads

Shortly after the launch of Marmite in the UK, yeast spreads became associated with the ability to provide a rich source of nutritional factors [39]. Shortly after, various studies had shown that people suffering anaemia and other vitamin related deficiencies could be



healed by the consumption of a spread made from spent brewer's yeast [10,11]. Much of these findings were underpinned by general nutritional deficiencies encountered by both soldiers and civilians during WWI in which Marmite was explicitly mentioned as the source of the nutritional factors (vitamins) that could overcome nutritional deficiencies [40–42]. Marmite was added to soldiers in the British army during WWI [11], which was continued in the British rations (Marmite) and Vegemite was added to the Australian rations in WWII [8]. Both Marmite and Vegemite emphasised the nascent nutritional credentials of their yeast spread products in their various independent advertisements with a focus on the nutritional status of children. These were all inspired by the medical findings as highlighted before. By focusing on childhood nutritional statuses in the era immediately following WWII, all yeast spread brands created an ingrained childhood memory of the “goodness” of the yeast spreads, which probably still pays dividend today.

## 5. Conclusions

All three national yeast spreads investigated in this study appear in the Top 10 of national food brands, indicating that all three brands are in the fore of the minds of people in all three countries. This was further reflected in the fact that in all three countries all passers-by recognised the national yeast spread from its common packaging. In Australia almost everyone identified Vegemite as a national icon, which in turn was reflected by the fact that 71% of Australians declared a ‘love’ for Vegemite compared to a very small percentage of ‘Vegemite haters’. The high level of iconisation of Vegemite appears to be manifested to the status of Vegemite as a symbol of national identity. Not only is this evidenced in the opinion of Australians, but it is also reflected in the ease by which Australians can rank their own national yeast spread as most favourable in a yeast spread identity parade. In the UK the iconisation of the national Marmite was less pronounced with 61% assigning an iconic status and only 43% of Brits declaring a ‘love’ for Marmite. Furthermore, overall the Brits were relatively indifferent when it came to ranking their own national yeast spread in a sensory yeast spread identity parade. The more balanced love/hate perception within the population and the more even spread of sensory opinions in a sensory ranking test is probably the underpinning reason for why the polarised perception of UK Marmite is readily exploited by the mass media and the marketing department of the Marmite masters. In sheer contradiction sits the New Zealand Marmite, with a reasonable high level of iconisation, but a relatively large part of the population who neither ‘loves’ or ‘hates’ the product. The New Zealand passers-by showed a similar appreciation for their own national Marmite and the Australian Vegemite. This leaves New Zealand content with two of the ‘big’ yeast spreads on the supermarket shelves. Overall, it still appears that New Zealanders will see their own Marmite as a product of national identity, but nowhere near the same as Vegemite for the Australians.

Despite their differences, the iconic status of the three national yeast spreads appears to be underpinned by the abundant medical evidence that came forward shortly after the launch of the first yeast spread in which Marmite was used as the source of nutritional factors that could treat a series of dietary deficiencies. All yeast spread brands capitalised on the same sources of medical evidence, to promote their products as healthy additions to a diet of growing children.

**Author Contributions:** Conceptualization, F.V.; methodology, F.V., supervision, F.V., C.R. and A.T.-C.; investigation, F.V., C.R., A.T.-C., C.J., M.B., S.F. and A.M.; data curation, F.V.; data analysis, F.V., C.J., S.F. and A.M.; writing first draft, F.V.; editorial, F.V., A.T.-C. and A.M.; project administration, F.V. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** This project received ethics approval from the Federation University (Australia) Research Ethics Committee (11-005) and the Harper Adams University (UK) Research Ethics Committee (111203-202078).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data can be made available by contacting the corresponding author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Notes

- <sup>1</sup> Williamson, J. True Blue. The very best of John Williamson. EMI music [true blue, is it . . . or just Vegemite], 1995.
- <sup>2</sup> Williamson, J. (Johnson, W. & Brown, B.) Give me a home among the gum trees. Sing-ing in the suburbs. Gumleaf Records [the place that I adore, . . . or Vegemite on toast], 1983.
- <sup>3</sup> Alan Weekes. TV Commercial, Happy little Vegemites. Kraft, Melbourne, Australia. [We are happy little Vegemites], 1954.
- <sup>4</sup> Men at Work. Down Under. Business as usual. CBS [he just smiled and gave me a Vegemite sandwich], 1982.
- <sup>5</sup> Bragg, B. England, Half English. Elektra Records, NY, USA. [I had a plate of Marmite soldiers], 2002.
- <sup>6</sup> Bown, A. Tick my box. Cherry Red Records, London, UK. [Marmite soldiers, they tick my box], 2011.
- <sup>7</sup> Wiley. Free Spirit. Own release on YouTube. [I never liked Marmite on toast], 2020.

## References

1. Kerby, C.; Vriesekoop, F. An overview of the utilisation of brewery by-products as generated by British craft breweries. *Beverages* **2017**, *3*, 24. [[CrossRef](#)]
2. Mudura, E.; Coldea, T.E.; Socaciu, C.; Ranga, F.; Pop, C.R.; Rotar, A.M.; Pasqualone, A. Brown beer vinegar: A potentially functional product based on its phenolic profile and antioxidant activity. *J. Serb. Chem. Soc.* **2018**, *83*, 19–30. [[CrossRef](#)]
3. Charlton, P.; Vriesekoop, F. Brewery by-products. In *Handbook of Brewing*; Stewart, G.G., Russell, I., Anstruther, A., Eds.; CRC Press: Boca Raton, FL, USA, 2017; pp. 567–590.
4. Kucharczyk, K.; Tuszyński, T.; Żyła, K.; Puchalski, C. The effect of yeast generations on fermentation, maturation and volatile compounds of beer. *Czech J. Food Sci.* **2020**, *38*, 144–150. [[CrossRef](#)]
5. Speers, R.A.; Stokes, S. Effects of vessel geometry, fermenting volume and yeast repitching on fermenting beer. *J. Inst. Brew.* **2009**, *115*, 148–150. [[CrossRef](#)]
6. Wadlow, C. The marmite election. *Intellect. Prop. Law Pract.* **2011**, *6*, 868–879. [[CrossRef](#)]
7. Symons, M. *A Continuous Picnic. A Gastronomic History of Australia*; Melbourne University Press: Carlton, Australia, 1987.
8. Richardson, K. Vegemite, soldiers, and rosy cheeks. *Gastronomica* **2003**, *3*, 60–62. [[CrossRef](#)]
9. Putman, R. Love it or Hate it—It’s one hundred years old. *Brew. Int.* **2002**, *2*, 27–29.
10. Harden, A.; Zilva, S.S. Oedema observed in a monkey: Fed on a diet free from the fat-soluble “A” accessory food factor and low in fat. *Lancet* **1919**, *194*, 780–781. [[CrossRef](#)]
11. Wilcox, W.H. Discussion on the treatment and management of diseases due to dietetic deficiencies. *Proc. R. Soc. Med. Lond.* **1920**, *13*, 7–22. [[CrossRef](#)]
12. Macpherson, W.G.; Herringham, W.P.; Elliott, T.R.; Balfour, A. History of the Great War based on official documents. In *Medical Services: Diseases of the War*; John Murray Publishers: London, UK, 1922; Volume 1.
13. Vaughan, J.; Hunter, D. The treatment by Marmite of megalocytic hyperchromic anemia: Occurring in idiopathic steatorrhea (Coeliac disease). *Lancet* **1932**, *219*, 829–834. [[CrossRef](#)]
14. Ungley, C. The effect of yeast and wheat embryo in anaemias. 1. Marmite, yestamin, and bemax in megalocytic and nutritional hypochromic anaemias. *Q. J. Med.* **1933**, *2*, 381–405.
15. Ungley, C.C. The extrinsic factor in anemia. *Lancet* **1936**, *228*, 768. [[CrossRef](#)]
16. Wills, L. The nature of the haemopoietic factor in Marmite. *Lancet* **1933**, *221*, 1283–1286. [[CrossRef](#)]
17. Mikkelsen, K.; Hallam, K.; Stojanovska, L.; Apostolopoulos, V. Yeast based spreads improve anxiety and stress. *J. Funct. Foods* **2018**, *40*, 471–476. [[CrossRef](#)]
18. Skarllicki, D.P.; Hoegg, J.; Aquino, K.; Nadisic, T. Does injustice affect your sense of taste and smell? The mediating role of moral disgust. *J. Exp. Soc. Psychol.* **2013**, *49*, 852–859. [[CrossRef](#)]
19. Xia, Y.; Zhong, F.; O’Mahony, M. Is the discrepancy between numbers derived from verbal and numerical protocols for 9-point hedonic scales an artifact of product choice? *J. Sens. Stud.* **2015**, *30*, 269–279. [[CrossRef](#)]
20. Rozin, P.; Siegal, M. Vegemite as a marker of national identity. *Gastronomica* **2003**, *3*, 63–67. [[CrossRef](#)]
21. Freeman, A. Love It or Hate It, Marmite Spread Turns 100 This Year. *The Globe and Mail*. 28 January 2002. Available online: <https://www.theglobeandmail.com/news/world/love-it-or-hate-it-marmite-spread-turns-100-this-year/article580986/> (accessed on 27 February 2022).
22. Anon. British Marmite ‘Crisis’ Reignites Aussie Vegemite Rivalry. *CTV News*. 14 October 2016. Available online: <https://www.ctvnews.ca/business/british-marmite-crisis-reignites-aussie-vegemite-rivalry-1.3115679> (accessed on 27 February 2022).
23. Holt, M. Free Marmite Being Handed out at the Ashes to Prove It’s Better than Vegemite. *Daily Mirror*. 6 August 2019. Available online: <https://www.mirror.co.uk/money/free-marmite-being-handed-out-18845123> (accessed on 27 February 2022).
24. Condie, S. Vegemite Strikes back at Marmite in the Ashes Battle of the Spreads. 9 August 2019, Stuff, New Zealand. Available online: <https://www.stuff.co.nz/business/world/114887449/vegemite-strikes-back-at-marmite-in-the-ashes-battle-of-the-spreads> (accessed on 27 February 2022).



25. Cumming, E. Nigella Lawson: Sorry, Marmite, It's Vegemite I love now. *The Times*. 5 September 2021. Available online: <https://www.thetimes.co.uk/article/nigella-lawson-sorry-marmite-its-vegemite-i-love-now-mmt0m3qfp> (accessed on 27 February 2022).
26. Kemisola, A.; Olaide, A. Understanding sensory evaluation of food. In *Food Science and Technology*; Ijabadeniyi, O.A., Ed.; De Gruyter: Berlin, Germany, 2020; pp. 345–362.
27. Stone, H.; Bleibaum, R.N.; Thomas, H.A. *Sensory Evaluation Practices*, 4th ed.; Academic Press: London, UK, 2012; pp. 81–115.
28. Carabante, K.M.; Prinyawiwatkul, W. Data analyses of a multiple-samples sensory ranking test and its duplicated test: A review. *J. Sens. Stud.* **2018**, *33*, e12435. [[CrossRef](#)]
29. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B. Appendix E. In *Principles of Sensory Evaluation of Food*; Academic Press: New York, NY, USA, 1965; pp. 526–527.
30. McKenzie, F. Trade, dominance, dependence and the end of the settlement era in Canada, Australia, New Zealand, South Africa, 1920–1973. In *Settler Economies in World History*; Lloyd, C., Metzger, J., Sutch, R., Eds.; Koninklijke Brill: Leiden, The Netherlands, 2013; pp. 463–489.
31. Holmes, M.; Burrows, R. Ping-pong poms: Emotional reflexivity in contemporary return migration from Australia to the United Kingdom. *Aust. J. Soc. Issues* **2012**, *47*, 105–123. [[CrossRef](#)]
32. Spoonley, P. New diversity, old anxieties in New Zealand: The complex identity politics and engagement of a settler society. *Ethn. Racial Stud.* **2015**, *38*, 650–661. [[CrossRef](#)]
33. Prideaux, J. Consuming icons: Nationalism and advertising in Australia. *Nations Natl.* **2009**, *15*, 616–635. [[CrossRef](#)]
34. Brien, D.L. From Waste to Superbrand: The Uneasy Relationship between Vegemite and Its Origins. *M/C J.* **2010**, *13*. [[CrossRef](#)]
35. House, A. Marketing Marmite: How an Advertising Agency Started a Culture War. *The Economist*. 17 June 2021. Available online: <https://www.economist.com/1843/2021/06/17/marketing-marmite-how-an-advertising-agency-started-a-culture-war> (accessed on 27 February 2022).
36. Jobling, A. Marmite Politics. 14 October 2016. Public Affairs Networking. Available online: <https://www.publicaffairsnetworking.com/news/marmite-politics> (accessed on 27 February 2022).
37. Asthana, A. How Brexit Turned Boris Johnson from Political Honey to Marmite. *The Guardian*. 18 September 2017. Available online: <https://www.theguardian.com/politics/2017/sep/18/how-brexit-turned-boris-johnson-from-political-honey-to-marmite> (accessed on 27 February 2022).
38. Lemon, G. 2018 Caught on Tape: The Story behind Australian Cricket's Greatest Fall. *The Guardian*. 14 November 2018. Available online: <https://www.theguardian.com/sport/2018/nov/14/caught-on-tape-the-story-behind-australian-cricket-greatest-fall> (accessed on 27 February 2022).
39. Gamgee, A. Are Yeast Extracts Justifiable as Substitutes for Extract of Meat? *Br. Med. J.* **1908**, *2*, 449–453. [[CrossRef](#)] [[PubMed](#)]
40. Colledge, L.; Drummond, H.; Worthington, R.T.; McNee, J.W.; Sladden, A.F.; McCartney, J.E. A report on the treatment of a series of recently inflicted war wounds with proflavine. *Lancet* **1917**, *190*, 676–677. [[CrossRef](#)]
41. Willcox, W.H. Rations in relation to disease in Mesopotamia, 1. *Lancet* **1917**, *190*, 677–678. [[CrossRef](#)]
42. Scurfield, H. The ABC of Vitamins. *Hosp. Health Rev.* **1922**, *1*, 191.