

Big Data Study for Gluten-Free Foods in India and USA Using Online Reviews and Social Media

Jolly Masih¹, Willem Verbeke¹, Jonathan Deutsch², Ashish Sharma³, Amita Sharma⁴, Rajasekaran Rajkumar⁵, Paviter Singh Matharu⁶

¹Erasmus School of Economics, Erasmus University, Rotterdam, The Netherlands

²Department of Culinary Arts & Food Science and Hospitality Management, Drexel University, Philadelphia, PA, USA

³Big Data Practice and Innovation Laboratory, New Jersey, USA

⁴Institute of Agribusiness Management, Bikaner, India

⁵School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, India

⁶Mosaic Company India Pvt. Ltd., Jalandhar, India

Email: jolly.iabm@gmail.com, verbeke@ese.eur.nl, st96d633@drexel.edu, ashishds@hotmail.com, amita@iabmbikaner.org, vitraj कुमार@gmail.com, paviter.iabm@gmail.com

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Abstract

Celiac disease, gluten-allergy or gluten-sensitivity is caused due to glutamine protein from the grains like wheat, rye and barley (collectively called gluten). This protein damages the small intestine and causes stomach pain, bloating, weakness etc. Celiac disease, gluten-allergy or gluten-sensitivity has never really been taken seriously in developing countries like India. However, in developed nations like UK, USA, Canada and other parts of Europe, gluten-free foods have become quite popular. With a prevalence rate of about one in 100 - 133 people worldwide, celiac disease is widespread across the globe and life-long consumption of gluten-free food is recommended treatment for this allergy. Apart from celiac-disease patients, gluten-free foods are also consumed by health conscious people for weight management and high protein diet and by the patients for diabetes, autism and food allergies. Apart from gluten-free flour, biscuits, cookies and snacks, product innovations like gluten-free beers are becoming very popular. Big data including online blogs, articles, and reviews have played a major role in increased sales of gluten-free foods. Thus, analysis of editorial and social media content becomes essential to understand the leading trends in gluten-free foods. This study provided deep insights about positive, negative and neutral sentiments related to gluten-free foods using the data from Perspectory Media Insights and Google Trends. This study also revealed that most of the consumers talked and expected product innovation in food sections like snacks, fast food (pizza, pasta and noodles) and desserts through comments on social and editorial media. Searches were divided into developed (e.g., U.S.A.) and developing nations

(e.g., India) to get more details about the consumer preferences. This study would help manufacturers of gluten-free foods to develop food products according to the choices and preferences of consumers. The study is very unique in itself since it combines big data to niche food market of gluten-free foods to draw the valuable consumer preferences using online platforms.

Keywords

Celiac Disease, Gluten-Free Food, Sentiment Analysis, Gluten Sensitivity, Social Media, Consumer Preference

1. Introduction

Celiac disease (CD) is an inherited, autoimmune disorder in which proteins from the grains wheat, rye and barley (collectively called gluten) damage the small intestine [1]. The only treatment for CD is a strict, lifelong gluten-free diet, with a prevalence rate of about one in 100 - 133 people worldwide [2]. Celiac disease is widespread across the globe [3]. Bowman Ingredients, in 2014 in Europe forecasted that sales volume would increase up to 40% in 2015 and that UK gluten-free market would rise to £250 million by 2017 [4]. Apart from gluten-free flour, biscuits, cookies and snacks, product innovations like gluten-free beers are becoming very popular. One such example is Lasso drinks' "Against the Grain" beer which has become quite popular [5]. Gluten-free (GF) products are consumed both by individuals with celiac disease and by health conscious people for weight management, high fiber and high protein diet and also by diabetic patients [6]. Due to reasons mentioned above the North America is the largest market for gluten-free products which accounted for a market share of 52% in 2014. The celiac disease incidence rate for Americans is one in 133. About three million Americans have celiac disease and a further estimated 40 million suffer from gluten-intolerance or sensitivity. It has been anticipated that the number of celiac patients is expected to double every 15 years [7]. It is dominated by various players, depending on their core competencies. The key players in this market are the Boulder Brands Inc., The Hain Celestial Group, Inc., Dr. Schar, General Mills, Inc., Kellogg's Company and The Kraft Heinz Company [7]. Restaurants are redoing their menus to attract gluten-free customers, food manufacturers are creating new products, and retailers are redesigning their stores [8]. Approximately, 10% of USA restaurants offer a gluten-free menu to attract 22% of gluten-free food consumers. The number of food items on restaurants' menus grew 9% from in 2012 to 24% in 2018 [9]. The global gluten-free market was projected to reach US\$6.2 billion by 2018, with North America contributing about 59% of the share [10].

Perceived as a "western disease", gluten sensitivity has never really been taken seriously in developing countries like India. Due to lack of awareness it has remained highly under-diagnosed [11]. According to Ramakrishna, celiac disease

is an impending epidemic [12]. As per Singh, India is an important global producer of important gluten-free sources such as sorghum, rice, corn, soybeans, millets, and pulses [13]. The gluten-free foods' market in Asia-Pacific region including India is estimated to grow from \$340.8 million in 2013 to \$502.5 million by 2018, at a CAGR of 8.1% from 2013 to 2018. Gluten-free bakery & confectionery segment has acquired the largest share of the gluten-free foods market in India [14].

Online blogs, articles and reviews have played a major role in increased sales of gluten-free foods. Thus, analysis of editorial and social media content becomes essential to understand the leading trends in gluten-free foods. Trend analysis via sentiment analysis and trend impressions provides in-depth analyses of public opinion and causes for those opinion [15].

Sentiment analysis is a type of natural language processing for tracking the mood of the public about a particular product or topic [16]. Sentiment analysis, which is also called opinion mining, involves in building a system to collect and examine opinions about the product made in blog posts, comments, reviews or tweets [17]. Sentiment analysis can be useful in several ways. For example, in marketing it helps in judging the success of an ad campaign or new product launching, determining which versions of a product or service are popular and even identifying which demographics like or dislike particular features [18]. The difference between sentiment analysis from editorial media and social media (Facebook, Twitter, Youtube) sentiment analysis is that text is short, usually one sentence composed of at most 140 characters, in the case of Twitter [19].

In this study, consumer preferences for gluten-free foods were analyzed on the basis of public sentiment obtained from social and editorial media data. The study provided deep insights about positive, negative and neutral sentiments related to gluten-free foods. The study also revealed that most of the consumers talked and expected product innovation in food sections like snacks, fast food (pizza, pasta and noodles) and desserts on social and editorial media. In this study, especial focus was laid to explore the top searched key words on editorial and social media related to gluten-free foods. Searches were divided into developed (e.g., U.S.A.) and developing nations (e.g., India) to get more details about the consumer preferences. This study would help manufacturers of gluten-free foods to develop food products according to the choices and preferences of consumers. The study is very unique in itself since it combines big data to the niche market of gluten-free foods to draw the valuable consumer preferences using on-line platforms.

2. Methodology

The editorial and social media data was crawled into excel format with help of an American data company "Perspectory Media Insights" [20] [21]. For editorial media, Perspectory Media Insights collects data from 240 million media outlets and Google Trends uses all the web and media portals connected to Google. In case of social media, Perspectory Media Insights has data contract with Face-

book, Twitter, Youtube, Instagram and all Google based blogging site to provide all the *non-protected freely accessible* data including comments, tweets, blog reports etc. Perspectory Media insights uses ‘Natural Language Processing technique’ to rate the public reviews or comments on editorial and social media as “positive”, “negative” or “neutral” sentiment. Positive sentiment includes good things which consumers wrote on editorial and social media (e.g., taste of gluten-free was good or I like organic gluten-free foods). Negative sentiment included about complaints or side-effects of gluten-free foods (e.g., gluten-free food are expensive, gluten-free are not healthy). Neutral sentiment included the general information related to gluten-free foods (e.g., gluten-free cookies are available at our store; I am recently diagnosed with celiac-disease-any comments for the diet please).

Other than Perspectory Media Insights, Google Trends [22] was used to get the list of most searched keywords and their growth percentages in developed and developing nations (see **Table 1** and **Table 2** for more details).

The editorial and social media data was taken for one year from 2016 to 2017 for this study.

The editorial data and social media data included the following:

- **Editorial data**—It included online newspapers, articles, research journals, reviews & forums. Data from websites of Celiac Society of India, Celiac Society of America, National Celiac Society of USA, Marketsand Markets report, Mintel and Nielsen database.
- **Social media data**—It included data from Facebook, Twitter, Pininterest, Youtube and Google Plus about gluten-free foods.
- **Keywords used to extract the data**—Gluten-free*, free from gluten*, wheat-free*, no gluten*, not gluten*, no wheat*, food for celiac*, without gluten*, gluten sensitive* + food, gluten-allergy* + food, celiac* + food, gluten-free + snack*, gluten-free + pizza*, gluten-free + pasta*, gluten-free + chocolate*, gluten-free + drink*, gluten-free + beer*, gluten-free + confectionary*, gluten-free + liquor*, gluten-free + bakery*, gluten-free + fast-food*, gluten-free + cereal*, gluten-free + cornflakes*, gluten-free + wine*, gluten-free + alcohol*, gluten-free + energy drink*, gluten-free + cookies*, gluten-free + savories*, gluten-free + juice*, gluten-free + noodle*.

All these keywords were searched independently for both editorial and social media one by one to prepare the consolidated reported.

Research tool: Perceptual mapping was used as research tool to study the trends of editorial media. Perceptual map was prepared based on weighted score of sentiment, number of articles and percentage share of articles. All the articles of editorial media were read thoroughly and their sentiment was decided based on text mining for each food category. Food categories taken into consideration were flour & mixes, fast food (including pizza & pasta), bakery, cereals & cornflakes, snacks, soft & energy drinks, liquor, confectionary and last category was desserts. Then, positive, negative and neutral sentiments for all articles were compiled into a total number for each food category. Total number of articles

Table 1. Top searched keywords on editorial and social media in developing countries e.g., India and their growth % in 2016-17 compared to 2015-16.

Keywords	Growth Percentage
Gluten free flour	550%
Chocolate brownie	400%
Tapioca	300%
Snack	290%
Rolled oats	250%
Chocolate chip cookie	240%
Peanut butter	210%
Amaranth grain	200%
Chocolate	190%
Muesli	180%
Gluten free grains	170%
Cookie	170%
Multigrain flour	170%
Dairy	160%
Pasta	160%
Organic food	160%
Sugar-free	150%
Affordable food	140%
Biscuits	140%
Flaxseed	130%
Noodles	130%
Namkeen	130%
Rice	120%
Lactose free food	120%
Indian cuisine	110%
South Indian dishes	110%
Bread	110%
Recipe	100%
Peanut	100%
Butter	100%
Brown rice	100%
Tasty gluten-free food	100%
Egg	100%
Cake	95%
Millet	95%
Oatmeal	90%
Cereal	90%
Weight loss	90%
Desserts	90%
Finger millet	85%

Continued

Almond flour	85%
Sorghum	80%
Veganism	70%
Dark chocolate	60%
Quinoa	60%
Banana	50%
Pastry	50%
Guargum	45%
Pizza	40%
Casein	35%

Source: Google trends, 2018.

for each category of sentiment were multiplied with their score allotted. Positive sentiment as given a score of 1.5, neutral sentiment was given a score of 1 and negative sentiment was given a score of 0.5. Dimensions used to prepare perceptual map was number of articles for each category and weighted score of each category based on sentiment analysis [15]. Formula used to prepare perceptual map is given below:

$$\begin{aligned} &\text{Score calculation for each food category} \\ &= (\text{No. of + ve article} * 1.5) + (\text{No. of neutral article} * 1) + (\text{No. of - ve article} * 0.5) \end{aligned} \quad (1)$$

$$\begin{aligned} &\% \text{ Share for each food category} \\ &= \frac{\text{Total Number of articles for a particular food category}}{\text{Total Number of articles for all the food categories}} \times 100 \end{aligned} \quad (2)$$

3. Results and Discussion

3.1. Global Sentiment Analysis for Gluten-Free Foods

1) Sentiment analysis via editorial media

Big data has been coined as a term denoting large or complex data sets. Big data analytics has been considered as the process of examining large data sets to unveil hidden patterns, unknown correlations, market trends, customer preferences and other useful business information. The goal of big data analytics is to make business decisions more accurate and prompt by enabling data scientists, predictive modelers and other analytics professionals to analyze large volumes of transaction data and to draw out meaningful results [23].

Sentiment analysis included the techniques to understand the attitude and mood of a speaker or a writer with respect to some topic or the overall contextual polarity of a document by determining the polarity of a given text as positive, negative, or neutral or as “angry”, “sad”, and “happy” [23] [24].

Figure 1 shows sentiment analysis via editorial media (also see **Appendix Figure 1** to see examples of editorial media). Keywords which fell in category of each sentiment are discussed below:

Table 2. Top searched keywords on editorial and social media in developing countries e.g., USA along with the growth % in 2016-17 compared to 2015-16.

Keywords	Growth Percentage
Christmas cookie	2100%
Chips & Krispies	1000%
Girl scout cookies	950%
Organic food	950%
Chicken wings	400%
Lentils	300%
Sugar cookie	300%
Taco bell	250%
Gluten-free beer	240%
Oatmeal	230%
Sourdough bread	200%
Corn tortilla	200%
Cheerios	200%
Hot chocolate	170%
Carbohydrate	160%
Ginger bread	160%
Meatballs	160%
Dominos	140%
Quinoa	140%
Whole grain	140%
Pasta	140%
Pancakes	130%
Wrap	120%
Cornmeal	120%
Cupcakes	120%
Pizza crust	120%
Donuts	120%
Cookies	120%
Banana bread	115%
Cinnamon roll	110%
Snacks	110%
Fried chicken	100%
Blueberry muffins	100%
Doritos	100%
Cider	100%
Low-carbohydrate diet	90%
King Arthur flour	90%
Cobbler	80%
Nutrition facts label	80%
Chickpea	80%
Granola	80%

Continued

Pie	80%
Bread roll	80%
coconut	80%
Macaroni and cheese	70%
bread	70%
Yogurt	70%
Cookie	70%
Cornbread	70%
Waffles	60%

Source: Google trends, 2018

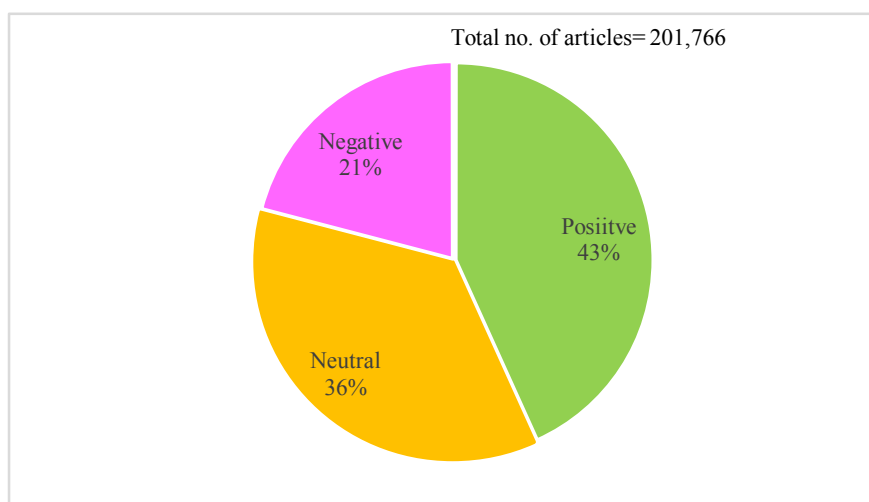


Figure 1. Global sentiment analysis via editorial media—2016-17. Source: Editorial media data obtained from Perspectory Media Insights.

Positive (53%)—Leading trends talked about these topics in relation to gluten free foods—organic food, marshmallows, reduce weight, oatmeal, Cheerios, Arrowroot, Peanut butter cookie, King Arthur flour, Panera bread, cider, doughnut, almond meal, quinoa, Dunkin Donuts, high energy level, improves skin and overall health, getting slim, Amaranth.

Neutral (43%)—Leading trends were cookies, allergy, beer, bakery, bread, bun, recipes, cracker, ginger bread, pop-corn, Zucchini fritters, Oatmeal, pan cake, banana bread, pizza.

Negative (4%)—Leading trends were Fad, diabetes, lack of dietary fiber, essential nutrients, French fries, candies, high carbohydrates, irritable bowel syndrome, reduce Bifidobacterium and Lactobacillus, food labels, high cost [20] [21].

2) Sentiment analysis via social media

Figure 2 shows sentiment analysis via social media. Following trends were discovered in each category of sentiment analysis (also see **Appendix Figure 2** to see examples of social media). Keywords which fell in category of each sentiment are discussed below:

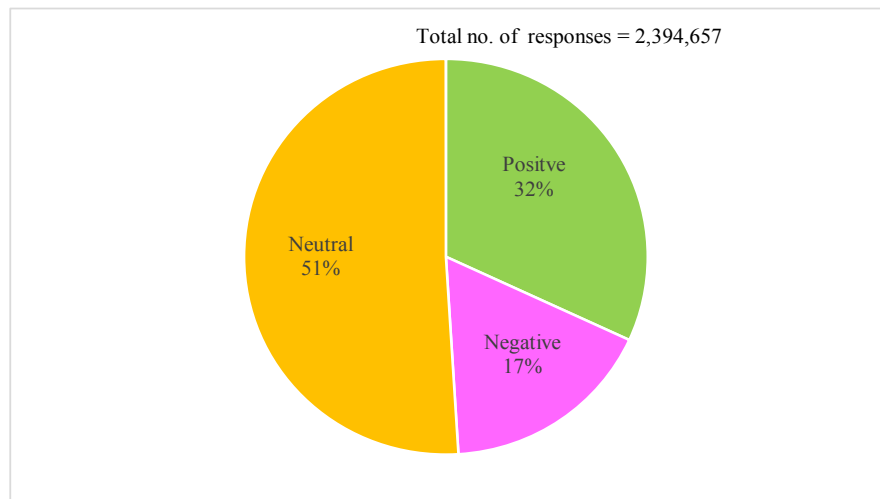


Figure 2. Global sentiment analysis via social media—2016-17. Source: Social media data obtained from Perspectory Media Insights

Positive (32%)—Rice Krispies, gluten-free bakeries, dark chocolates, gluten-free oats, gluten-free travel and restaurants, gluten-free menu, fish & chips, choco chip cookies, gluten-free flour mixes, nut milk, coconut milk and gluten-free beer, McDonalds gluten-free menu.

Neutral (51%)—Dairy-Free & Vegan Options, Protein Bar, noodle soup, Tortilla Chips, beef and chips, pop-corn, Indian grains, ragi, millets, white rice, jowar, soy and rice flour, gluten-free cornflakes, pizza crust, bread, desserts, baking crust, cake, pan cake cookie.

Negative (17%)—Obesity, high sugar, high carbohydrate, taste, availability on nearby store, wheat contamination, lack of proteins and micro-nutrients, dough binding ability, expensive, skin rash, lactose intolerance and diabetes [20] [21].

Figure 3 shows social analysis by channel. Mainly five channels were used to extract the data from social media namely Twitter, Facebook, Instagram, Blogs and Youtube.

Twitter (49.10% responses) was favorite platform been used the public to put their opinions about gluten-free foods. Many micro blogs were also written by dieticians, nutritionists and food experts, where news recipes of gluten-free foods were discussed along with healthy gluten-free options.

Facebook (23.16% responses) was also popular platform. Many groups and health websites had been formed on Facebook by users of gluten-free foods e.g. Gluten Free, Free From Gluten, Gluten Dude, NYC Celiac Disease and Gluten-Free Meetup, Gluten-free Mama, Celiac group of Mumbai India, Gluten Free, Free From Gluten, Gluten Dude, NYC Celiac Disease and Gluten-Free Meetup, Gluten-free Mama, Celiac group of Mumbai India etc.

Instagram (14.52% responses) has gained high popularity in last few years. Few famous Instagram pages were #glutenfree, gluten.free.me, udisglutenfree, gluten_freeeats, Australian Gluten-Free Life. People posted pictures and share recipes of gluten-free foods.

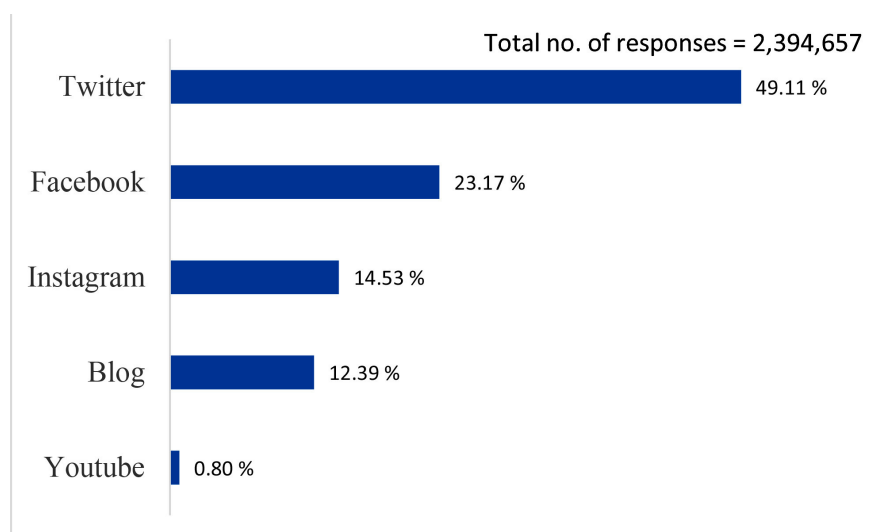


Figure 3. Social media analysis by channel across the globe—2016-17.

Blogs (12.22% responses) contributed a lot to create awareness about gluten-free foods. Many blog writers discussed benefits and harms of consuming gluten-free diet. Emphasis was also given to new recipes which were good in taste and high in nutrition.

Youtube (1% response) had lowest response rate. However, few famous Youtube videos on gluten-free foods were What Gluten-Free Really Means, 30 Days Of A Gluten-Free Diet, How to Go Gluten-Free, Gluten Free Foods List, Gluten-Free vs. Gluten Taste Test and Top 10 Gluten Free Dishes [20] [21].

3.2. Top Searched Keywords on Google for Gluten-Free Foods

Table 1 shows that in India, Gluten free flour, Chocolate brownie, Tapioca, Snack and Rolled oats were top five most searched keywords in 2016-17 as gluten-free foods in India are at a niche stage and most of the people look for basic eatables like flour and snacks (also see **Appendix Figure 3** to see word cloud of most popular keywords related to gluten-free foods in India). Chocolate chip cookie, Peanut butter and Amaranth grain achieved growth rate of 200% or higher and are expected to grow further due to increased public consumption. Chocolate, South Indian Dishes, Gluten free grains, Cookie, Multigrain flour, Dairy, Organic food, Sugar-free, Affordable food, Biscuits, Flaxseed, Noodles, Namkeen, Rice, Lactose free food, Indian cuisine, Maize, Pasta and Bread registered growth rate above 100% and were kind of stable trends and were in demand round the year [22].

Few leading brands in India offering gluten-free food were Dr.Schar, Dr. Gluten, Zero G, Kalpana foods, Savorlife, Bewell, Wheafree etc.

Table 2 shows that in USA, Christmas cookies, Chips & krispies, Girl Scout Cookies, organic foods and Chicken wings were top five most searched keywords due to their high demand in Christmas New Year week in 2016-17 and they witnessed highest growth rates as compared to year 2015-16 (also see **Ap-**

pendix Figure 4 to see word cloud of most popular keywords related to gluten-free foods in USA). Lentils, Sugar cookie, Taco bell, Gluten-free beer, Oatmeal, Sourdough bread, Corn tortilla and Cheerios achieved growth rate of 200% or higher and were expected to grow further due to increased food consumption. Hot chocolate, Carbohydrate, Organic foods, Meatballs, Dominos, Quinoa, Whole grain, Pasta, Pancakes, Wrap, Cornmeal, Cupcakes, Pizza crust, Donuts, Cookies, Banana bread, Cinnamon roll and Snacks registered growth rate above 100% and were kind of stable trends and were in demand round the year [22].

Few leading brands in USA offering gluten-free foods were Dr.Schar, Udi's, Pamela's, Glutino, Marry gone, Wholefoods, Trader Joe's, Amy's, Blue Diamond, Cheerios etc.

3.3. Exploring Consumer Preferences for Gluten-Free Foods Using Perceptual Map

Figure 4 and **Table 3** show a global perceptual map for different food categories of gluten-free foods based on the data of editorial media. From the map it was clear that snacks was the leading food section across the world with 17% share of articles. Many new products were launched with different ingredients and better taste. Few popular snacks were Blue Diamond Pecan Nut-Thins (made of rice flour and pecans), Barbeque Popchips (potato chips), Mary's Gone Crackers (brown rice, quinoa, flax seeds, and sesame seeds), Food Should Taste Good Multigrain Tortilla Chips (corn chips), Schar Pretzels, Baked Cheese Crunchies and Organic Stone Ground Blue Corn Chips by Trader Joe's. People were buying different types of multigrain and whole grain snacks with special herbs. Pizza, pasta and fast food with 13% share of articles was second leading category. Famous brands were Amy's, Udi's, Dominos, Schar and local pizza and pasta cafes with their specialties. Frozen pizzas, pizza crust and pizza base of different type were also in high demand. In pasta and noodles, Thasia, NutraHi and Schar were few popular brands. In confectionery and desserts with 13% share of articles and weighted score of 46714 and 44085 respectively, local bakers were more popular as they provided fresh products at affordable prices instead of packed ones. Most of the editorial articles discussed about local recipes as they were more liked by consumers. Liquor and Bakery had 12% share of articles. Bakery section was led by local bakeries but bakery products by Wholefoods, Trader Joe's, Schar, Pamela's and Udi's were also quite famous. Ginger bread, banana bread, cinnamon bread were also getting popular. In liquor section few famous beers were Buck Wild Pale Ale, Redbridge Lager, Dragon's Gold (Fruit Beer), American Pale Ale, India Pale Ale, Mikkeller Cream Ale, Brasseurs Sans Gluten Glutenberg Blanche and Lasso Gluten-free beer. Flour & mixes (10% share of articles) were stable in nature as most of users of gluten-free foods bought them most of the times. Multigrain and wholegrain flours and mixes were in high demand. Flour mixes prepared from brown rice, quinoa, sorghum, amaranth, almond etc were preferred over plain corn or rice flour. King Arthur,

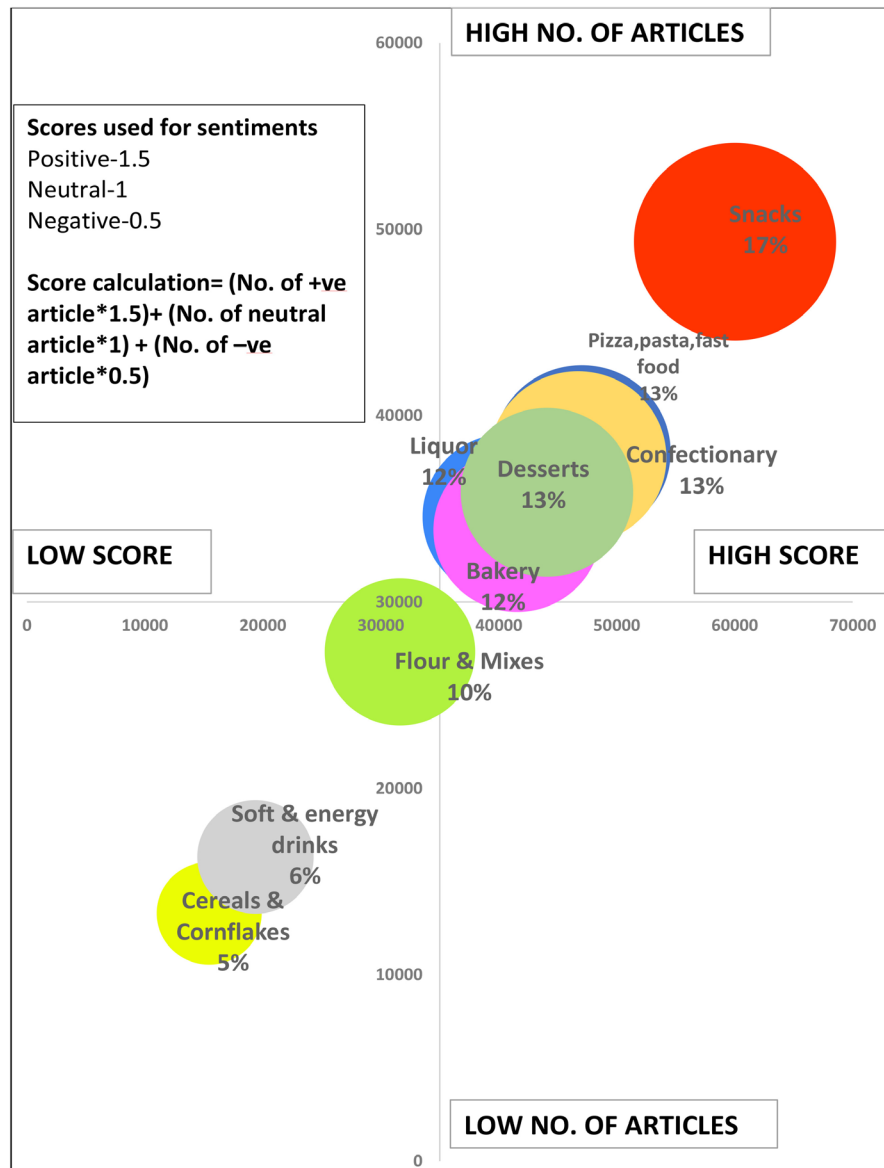


Figure 4. Perceptual map of gluten-free food across the globe for year 2016-17.

Bob red mill, Nature pro, Dr.Gluten, Dr. Schar and Glutino were few famous brands. Soft drinks and energy drinks (6% share of articles) were most of the time naturally gluten-free. Fresh juices or juices with fruit pulp were preferred by users. Cereals and flakes (5% share of articles) had very narrow product brand. Post coco pebbles, gluten-free flakes by Kellogg's and Nestle, Cheerios Oatmeal were few popular brands [15] [23] [24] (also see **Appendix Figure 5** and **Appendix Figure 6** for more details).

4. Conclusion

Big data analysis revealed that maximum online searched about gluten-free foods on editorial and social media were made in developed nations like USA, which had high availability and huge variety of gluten-free foods. Gluten-free

Table 3. Score obtained from perceptual map of gluten-free food across the globe for year 2016-17.

Food Items	Score	No. of Articles	% Share of Articles
Flour & Mixes	31626	27328	10%
Pizza, pasta, fast food	47043	38054	13%
Bakery	40718	34585	12%
Cereals & Cornflakes	15454	13299	5%
Snacks	60031	49336	17%
Soft & energy drinks	19375	16324	6%
Liquor	41558	33864	12%
Confectionary	46714	37744	13%
Desserts	44085	35891	13%

Source: Author's own compilation from editorial media data obtained from Perspectory Media Insights data crawlers.

foods in developing nations like India were at a very niche stage, and users here searched for very basic food options like gluten-free flour, biscuits, snacks and noodles. It was observed that data volume of social media was very high compared to editorial media as people posted many things of social media especially on Twitter about gluten-free diet. However, in editorial media only journalists, blog writers and researches publish their findings and opinions about gluten-free food. The study also revealed that most of the consumers talked and expected product innovation in food sections like snacks, fast food (pizza, pasta and noodles) and desserts on social and editorial media. This study would provide direction to manufacturers of gluten-free foods to develop food products according to the choices and preferences of consumers based on ideas and reviews obtained from social and editorial media. The study is very unique in itself since it combines big data to the niche market of gluten-free foods to draw the valuable consumer preferences using online platforms.

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Limitations of the Study

The world of social media and editorial is very big and immense. Perspectory

Media Insights collects data from 240 million media outlets and Google Trends uses all the web and media portals connected to Google. However still there are chances that a lot of media portals remain touched in this research due to difficulty in accessing them. Thus, the data about editorial and social media on gluten-free foods is mere representation of big data obtained from Perspectory Media Insights and does not claim the data from whole web universe.

Conflicts of Interest

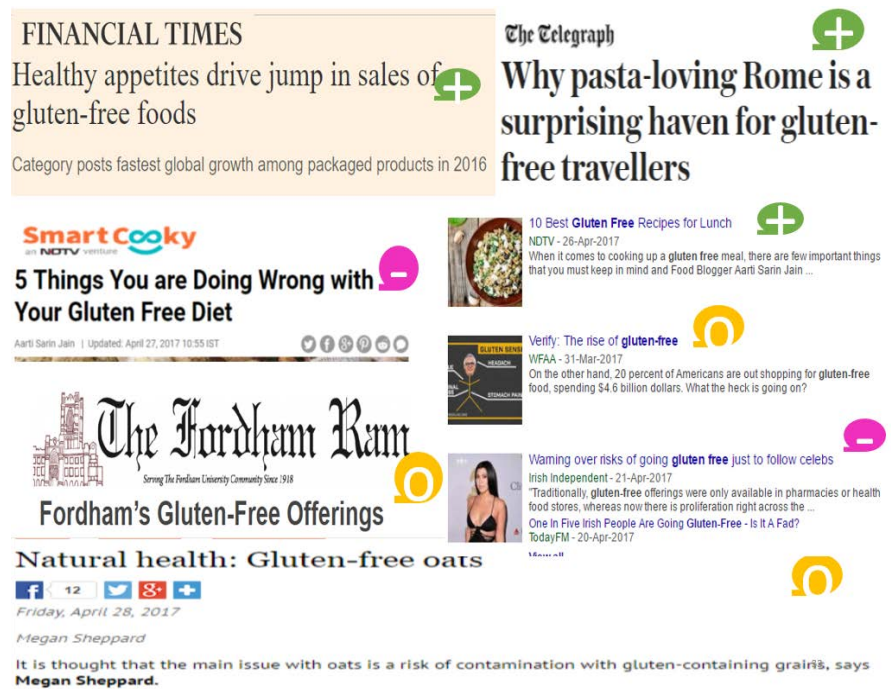
The authors claim no conflict of interest with anyone about this research.

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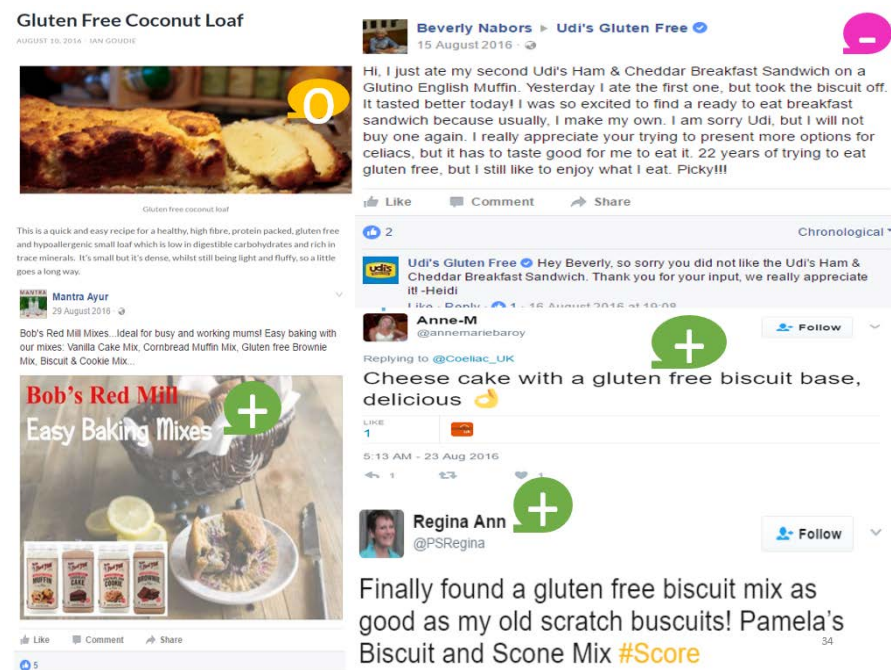
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Appendix



Appendix Figure 1. Examples for sentiments analysis of editorial media. In the about figure various examples and their related sentiments have been shown from editorial media. Green circle has been used for positive sentiment, pink circle for negative and brown circle for neutral sentiment.



Appendix Figure 2. Examples for sentiments analysis of social media. In the about figure various examples and their related sentiments have been shown from editorial media. Green circle has been used for positive sentiment, pink circle for negative and brown circle for neutral sentiment.



Appendix Figure 3. Word cloud for gluten-free foods in India. Word cloud provides a glimpse of most common keywords been associated with gluten-free food in India. Bigger size words indicate higher popularity of a particular keyword compared to other keywords. In India rice, celiac disease, Wheafree, Dr. Schar, gluten-free flour and chocolate cookies are most commonly used keywords, in context of gluten-free foods.



Appendix Figure 4. Word cloud for gluten-free foods in USA. Word cloud of USA is densely populated, since it has many popular keywords associated with gluten-free foods. Most popular keywords are Udi’s, bread, flour, celiac disease, veganism, autism, lactose-intolerance, biscuits, Pamela’s, rice, quinoa, malnourished and local bakeries.

Date	Headline	URL	Hit Sentence	Source
21-Jul-2016 01:50AM	General Mills takes Cheerios gluten-free in Canada	http://www.just-food.com/news/general-mills-cereal-brand-cheerios-is-going-gluten-free-in-canada-just-food		Just-Food
20-Jul-2016 11:08PM	Dal 20 luglio nuove etichettature per i prodotti "gluten-free"	http://www.intopic.it/notizie/10347306/		Intopic
20-Jul-2016 01:12PM	Mum calls for clearer gluten labelling after Coeliac son gets sick	https://www.tvnz.co.nz/one-news/new-zealand/the-packet-should-be-clearer-because-her-son-tvnz		TVNZ
20-Jul-2016 09:25AM	Introducing Enjoy Life Mini Cookies Gluten Free On The Go	http://en.paperblog.com/introducing-enjoy-life-mini-cookies-gluten-free-on-the-go-paperblog-en		EN
20-Jul-2016 07:04AM	Cheerios Goes Gluten-Free	http://www.newswire.ca/news-releases/cheerios-requirements-and-standards-for-gluten-free-pr-OWN-Group		OWN Group
20-Jul-2016 04:41AM	No gluten v gluten free: Boy with Coeliac disease finds out difference the hard way	https://www.tvnz.co.nz/one-news/new-zealand/gluten-free-or-no-gluten-what-s-the-difference-tvnz		TVNZ
20-Jul-2016 04:40AM	Meet the bagel shop owner who had to give up gluten	http://politico.pun.ch/news/meet-the-bagel-shop-owner-who-gave-up-gluten-gejerman-a-bagel-shop-owner-who-politico-pun		PoliticoPunch
20-Jul-2016 03:21AM	Sparkling Iced Tea (gluten free, dairy free, veggie and vegan friendly)	http://www.mydubainews.com/?p=20750		My Dubai News
20-Jul-2016 03:01AM	Hobbs House Bakery creates gluten-free Gift	http://www.bakeryinfo.co.uk/news/fullstory.php?vid=101119248&tid=101119248		British Baker Magazine
20-Jul-2016 12:33AM	Sparkling Iced Tea (gluten free, dairy free, veggie and vegan friendly)	http://www.curiosityme.com/2016/07/20/sparkling-iced-tea-gluten-free-dairy-free-vegan-friendly/		Curiosity Middle East
19-Jul-2016 08:39PM	Low Cholesterol - Video Dailymotion	http://www.dailymotion.com/video/x4kxw1_ebookkingdom.info/?book=80194PHXCO Download India - Dailymotion		Dailymotion
19-Jul-2016 12:17PM	Gluten-free baking products maker earns support for exports	http://myinform.com/en-ca/a/38669904-gluten-free-baking-products-maker-earns-support-for-exports		MyInform.com
19-Jul-2016 12:15PM	Gluten-free baking products maker earns support for exports	http://www.cbc.ca/news/canada/prince-edward-a-manufacturer-of-gluten-free-cookie-cake-and-1-cbc-news-canada		CBC News - Canada
19-Jul-2016 10:13AM	Download Cooking with Coconut Flour: A Delicious Low-Carb Gluten-Free Alternative to Wheat - Video Dailymotion	http://www.dailymotion.com/video/x4kxw3_/download.ebookkingdom.info/?book=09415999_India - Dailymotion		Dailymotion
19-Jul-2016 10:13AM	Read The Gluten-Free Gourmet Bakes Bread: More Than 200 Wheat-Free Recipes PDF	http://www.dailymotion.com/video/x4kxw2_r/download.ebookkingdom.info/?book=0801_India - Dailymotion		Dailymotion
19-Jul-2016 08:33AM	Free - Video Dailymotion	http://www.dailymotion.com/video/x4kxw2_r/download.ebookkingdom.info/?book=0801_India - Dailymotion		Dailymotion
19-Jul-2016 08:33AM	Sparkling Iced Tea (gluten free, dairy free, veggie and vegan friendly)	http://www.azadnews.com/en/631/52481-		Azad News
19-Jul-2016 07:56AM	Kourtney Kardashian reveals top beauty secrets and why she's gluten and dairy-free	http://www.msn.com/en-au/lifestyle/style/kou/	#NAME?	MSN - Australia

(a)

Influencer	Country	Subregion	Language	Reach	AVE	Sentiment	Key Phrases	Input Name
Katy Askw	United Kingdom	-	English	9195	85.05375	Neutral	Cereal brand Cheerio, General Mills, Canada, summer, different varieties	Adhoc Search Export
-	Italy	Undef regional	Italian	121378	1122.7465	Positive	alimenti senza glutine, termini di rimborabilità, etichettatura, free, gluten, prod	Adhoc Search Export
-	New Zealand	Undef regional	English	922328	8531.534	Negative	muesli bar, Fair Go, Pure Delish bar, Coeliac son, bar Leo, packet, front, mother, egg	Adhoc Search Export
Calvin Eaton	France	Undef regional	English	595018	5503.9165	Positive	EnjoyLife Foods, product, Crunchy & Soft Baked Mini Cookies, Chocolate Chip, Engi	Adhoc Search Export
-	Canada	-	English	367127	3396.75725	Neutral	General Mills, Honey Nut Cheerios, Cheerios, summer, Canadians, free Cheerios pr	Adhoc Search Export
Brodie Kane Fair Go Reporter	New Zealand	Undef regional	English	922328	8531.534	Negative	Pure Delish bar, difference, egg and dairy, gluten, tiny amount, packet, lowest tea	Adhoc Search Export
-	Switzerland	-	English	0	0	Negative	bagel shop owner, bagel, beer, bread, counter, cups, coeliac disease, First Avenue, a	Adhoc Search Export
Adel	United Arab Emirates	Undef regional	English	0	0	Neutral	Iced Tea, Moroccan tea bags, Beat Diabetes initiative, Ice cubes, 250ml Sparkling	Adhoc Search Export
By Ashley Williams	United Kingdom	South East and L	English	0	0	Positive	British Baker, free bread, loaf, awards ceremony, brand, Product, free intolerant, c	Adhoc Search Export
-	United Arab Emirates	Undef regional	English	0	0	Neutral	Moroccan tea bags, Iced Tea, 250ml Sparkling water, bags, new window, Ice cube	Adhoc Search Export
-	India	National regiona	English	89927266	831827.2105	Neutral	http://download.ebookkingdom.info/?book=80194PHXCO Download Diabetic C	Adhoc Search Export
-	Canada	-	English	0	0	Neutral	government money, cake and bread, exports, free baking products maker, Duinke	Adhoc Search Export
By Kevin Yarr, CBC News	Canada	Undef regional	English	9670654	89453.5495	Neutral	exports, Slemon Park, Duinkerken Foods, cake and bread, free baking products m	Adhoc Search Export
-	India	National regiona	English	89927266	831827.2105	Neutral	http://download.ebookkingdom.info/?book=09415999639 Download Cooking, De	Adhoc Search Export
-	India	National regiona	English	89927266	831827.2105	Neutral	http://download.ebookkingdom.info/?book=0805060782 Read, Gourmet Bakes	Adhoc Search Export
-	United Arab Emirates	Undef regional	English	0	0	Neutral	Iced Tea, Moroccan tea bags, Beat Diabetes initiative, Ice cubes, 250ml Sparkling	Adhoc Search Export
Claire Rutter	Australia	Undef regional	English	2446375	22628.96875	Negative	coconut oil, swimming pool, lip balm, Kourtney Kardashian, beauty brand, Manuka	Adhoc Search Export
Claire Rutter	New Zealand	-	English	469168	4339.804	Negative	coconut oil, swimming pool, lip balm, Kourtney Kardashian, beauty brand, Manuka	Adhoc Search Export

(b)

Appendix Figure 5. Sample for editorial media data sets. Source: Perspectory Media Insights, 2016-17.

Outlet/Publication	Date	Headline	Hit sentence	Url
facebook.com	08/25/16 19:18	Anzac biscuits dough Carmel fudge Gingerbread Gluten free c... by Natasha Laura Ross Erd	Anzac biscuits dough Carmel fudge Gingerbr	http://www.facebook.com/322193564492136/posts
facebook.com	08/25/16 17:40	Gluten Free Chicken Enchilada Biscuit Bake by Gluten Free Carla - Carla Spacher of Gluten F	Gluten Free Chicken Enchilada (Fluffy) Biscu	http://www.facebook.com/132286276783022/posts
facebook.com	08/25/16 14:38	Today I visited Bea's London for a gluten free afternoon tea... by Fiona Gregory	tasty. The scene was a disaster and resent!	http://www.facebook.com/941334004/posts/1015-
facebook.com	08/24/16 11:48	Timeline Photos by Alexis's Gluten Free Adventures	Bella Gluten-Free biscuit mix is so good. I c	http://www.facebook.com/358168717561160/posts
facebook.com	08/23/16 11:28	Dear McVities I love your new gluten free chocolate hob no... by Katherine Morris-Brown	Dear McVities I love your new gluten free ch	http://www.facebook.com/168215896610876/posts
facebook.com	08/22/16 19:09	Best Gluten-Free Biscuit Recipes Best Gluten-Free Roll Recip... by gfe-gluten free easily	"WHEN I CAN'T WRITE A POEM. I MAKE IT"	http://www.facebook.com/240654019434/posts/10
facebook.com	08/20/16 17:04	Gluten Free Old Fashioned Blueberry Cobbler - Laura's Gluten... by Laura's Gluten Free Kitch	People now days make cobbler as pies or v	http://www.facebook.com/367527544336217/posts
facebook.com	08/19/16 10:14	HELPIII I am desperately trying to find your gluten free pr... by Kaia Joyce-Daniels	HELPIII I am desperately trying to find your	http://www.facebook.com/195184929662/posts/10
facebook.com	08/17/16 07:08	Gluten Free Berry Cobbler by Gluten Free Recipes	Gluten Free Grain Free Berry Cobbler. Don't	http://www.facebook.com/62728927666257/posts
facebook.com	08/16/16 20:38	So happy I found Chebe products since going Gluten Free... by Bobbie Gaiski Van Busker	So happy I found Chebe products since goin	http://www.facebook.com/127596103943938/posts
facebook.com	08/15/16 17:32	Mary I have become gluten free after some surgeries. Can yo... by Kathy Piccaux	Mary I have become gluten free after some s	http://www.facebook.com/178642445613573/posts
facebook.com	08/15/16 14:13	12 Essential Gluten-Free Eats in Charleston by Fairfield Inn & Suites Charleston Airport/Com	Are you gluten intolerant? No worries! Eat	http://www.facebook.com/3853484849141/posts
facebook.com	08/14/16 11:20	Gluten Free Garlic & Herb Cheese Biscuit by Studio Botanica - Herbs & Natural alternatives fo	Gluten Free Garlic + Cheese Biscuits? Than	http://www.facebook.com/14523933883074/posts
facebook.com	08/13/16 17:51	Gluten-Free Homemade Red Lobster Garlic Cheese Biscuits by gfe-gluten free easily	HOMEMADE GF RED LOBSTER GARLIC C	http://www.facebook.com/240654019434/posts/10
facebook.com	08/11/16 02:01	Dairy Free Chocolate Caramel Cubes Gluten Free Soya Free by CMPA Support	Dairy Free Chocolate Caramel Cubes. Also	http://www.facebook.com/455498719222310/posts
facebook.com	08/09/16 15:00	Blend11 Gluten Free Anzac Biscuits - goodMix Superfoods by goodMix	Want some traditional Anzac biscuit recipe?	http://www.facebook.com/498029156532297/posts
facebook.com	08/04/16 17:29	Class How To Make GF Eclairs by Gluten Free Cooking School	before the live class on Saturday. Link to re	http://www.facebook.com/111355408931693/posts
facebook.com	08/03/16 11:47	Just got very excited on seeing the gluten free hobnobs in... by Jo Bowden	Just got very excited on seeing the gluten fr	http://www.facebook.com/168215896610876/posts

(a)

Outlet/Publication	Country	Date	Headline	Hit sentence	Url
cottercrunch.com	United States	08/21/16 07:28	Kid Friendly Gluten Free Meal Plan (Recipe Ideas)	to maximize their growth and health	http://www.cottercrunch.com/kid-friendly-glu
tinynewyorkkitchen.com	United States	08/19/16 08:47	Gluten-Free Peach Cobbler	I love this classic New England cobb	http://www.tinynewyorkkitchen.com/recipe-i
allergicigil.blogspot.com	Australia	08/17/16 08:30	Recipe Blueberry Com Drop Scone Gluten-Free Nut-Free	Blueberries and com. Didn't think th	http://allergicigil.blogspot.com/2016/08/recei
jujey.com	United States	08/16/16 14:30	Living the Gluten Free Life	just wanted the ground to eat me u	http://www.jujey.com/2016/08/living-gluten-
glutenfreegodess.blogspot.com	India	08/13/16 03:00	Gluten-Free Peach Cobbler	Better From Scratch. I started out	http://glutenfreegodess.blogspot.com/2016/08/
langoude.wordpress.com	Canada	08/10/16 05:03	Gluten Free Coconut Loaf	Gluten free coconut loaf This is a qu	http://langoude.wordpress.com/2016/08/11
gseasyrecipes.blogspot.com	United Kingdom	08/06/16 07:58	EGGLESS GLUTEN FREE RED CAKE!	microwave string well then spread	http://gseasyrecipes.blogspot.com/2016/08/
thellextdoor.com	United States	08/03/16 02:06	GLUTEN FREE AFTERNOON TEA AND BABEIN DRESSES	I am 100% in love with and hope yo	http://www.thellextdoor.com/2016/08/03/

(b)

Country	Date	Headline	Hit sentence	Url
United Kingdom	08/29/16 17:29	copperconfetti White chocolate cheesecake with raspberries 🍓H gluten free biscuit base worked well if a bit ... h	copperconfetti White chocolate c	http://twitter.com/copperconfetti/statuses/
United Kingdom	08/29/16 12:40	GlutenFreeHelen My boyfriend's granny has a biscuit tin filled with gluten free snacks just for me. Such a thought	GlutenFreeHelen My boyfriend's	http://twitter.com/GlutenFreeHelen/status/
United States	08/29/16 08:32	OmniNashville Daily Biscuit Flavors Sweet, Cinnamon Raisin, Savory, 3 Cheese, Classic, Buttermilk + Gluten-F	OmniNashville Daily Biscuit Flav	http://twitter.com/OmniNashville/statuses/
United States	08/29/16 02:24	ItalianCakeCofi MANDORLE, Almond-orange Italian biscuit, Gluten free! Made here ♥️ #almond biscuit #italian	ItalianCakeCofi MANDORLE. Aln	http://twitter.com/ItalianCakeCofi/statuses/
United States	08/29/16 01:01	ItalianCakeCofi Pastine, Almond-lemon Italian biscuit, Gluten free! Made here ♥️ #almond biscuit #italian biscuit #	ItalianCakeCofi Pastine, Almond-	http://twitter.com/ItalianCakeCofi/statuses/
United Kingdom	08/29/16 15:55	TalkingGoodFood RT @makeitglutfree: My first #Glutenfree Strawberry Cheesecake with Gluten Free #Hobnobs, a gre	TalkingGoodFood RT @makeitgl	http://twitter.com/TalkingGoodFood/status/
India	08/29/16 15:53	hopperkca RT @makeitglutfree: My first #Glutenfree Strawberry Cheesecake with Gluten Free #Hobnobs, a gre	hopperkca RT @makeitglutfree:	http://twitter.com/hopperkca/statuses/769
United Kingdom	08/29/16 15:19	makeitglutfree My first #Glutenfree Strawberry Cheesecake with Gluten Free #Hobnobs, a great biscuit base me	makeitglutfree My first #Glutenf	http://twitter.com/makeitglutfree/statuses/
New Zealand	08/29/16 14:40	Soulshine_Vegan I tried a gluten free biscuit recipe that showed a pic of "fluffy" of biscuits but lies @👀👀... http	Soulshine_Vegan I tried a gluten	http://twitter.com/Soulshine_Vegan/status/
India	08/27/16 22:12	TrickyRickee_13 "Juan eating Popeyes today" Juan: "Do you want my biscuit?" Me: "I've been gluten free for a m	TrickyRickee_13 "Juan eating P	http://twitter.com/TrickyRickee_13/status/
United States	08/27/16 19:28	Intweets A healthier you is easier than you think! 100 Calorie Gluten Free Chocolate Biscuit Bars 🍫🍫🍫🍫🍫	Intweets A healthier you is easie	http://twitter.com/Intweets/statuses/7696
India	08/27/16 07:27	selloscope15 Save 23% - Pamela's Products Gluten Free Biscuit and Scone Mix, 13 Ounce https://h.co/jL6jMK	selloscope15 Save 23% - Pamel	http://twitter.com/selloscope15/statuses/7
South Africa	08/26/16 04:38	CoconutConnect1 @Iezek Yum sugar free gluten free biscuit tasters @CoconutConnect1 stand at @earthfarma	CoconutConnect1 @Iezek Yum	http://twitter.com/CoconutConnect1/status/
United States	08/25/16 11:42	NewRiverDining Anyone in #glutenFree land have the best recipe for a light, fine, pate sablee style biscuit that do	NewRiverDining Anyone in #glute	http://twitter.com/NewRiverDining/statuses/
United Kingdom	08/25/16 10:30	HugsandHearts Homemade gluten free peanut butter cookies (my eldest son is a biscuit monster but was recen	HugsandHearts Homemade glute	http://twitter.com/HugsandHearts/statuses/
United States	08/25/16 08:34	OmniNashville Today's Biscuit Flavors of the Day Sweet, Butterscotch, Savory, Tomato + Basil, Classic, Butter	OmniNashville Today's Biscuit Fl	http://twitter.com/OmniNashville/statuses/
United Kingdom	08/25/16 07:19	TalkingGoodFood RT @Glutarama: @NEWSLETTER: New Gluten Free Biscuit Recipe Book, this months TOP	TalkingGoodFood RT @Glutaram	http://twitter.com/TalkingGoodFood/status/
United Kingdom	08/25/16 07:00	Glutarama @NEWSLETTER: New Gluten Free Biscuit Recipe Book, this months TOP free recipes and intoleran	Glutarama @NEWSLETTER: Ne	http://twitter.com/Glutarama/statuses/768
United Kingdom	08/24/16 16:12	tallolser @EmSnInNederland nope but probably because they're gluten free ones and are more like a biscuit by	tallolser @EmSnInNederland no	http://twitter.com/tallolser/statuses/768
Netherlands	08/24/16 16:01	bubbleadodie my mum bought gluten free tea cakes (she's coeliac) but they have no biscuit in them ?? by bub	bubbleadodie my mum bought	http://twitter.com/bubbleadodie/statuses/
India	08/24/16 12:42	EUTAX131 I think Dathi's quip - was the biscuit gluten free? - would have got him ex-communicated. Was very of	EUTAX131 I think Dathi's quip -	http://twitter.com/EUTAX131/statuses/768
United States	08/24/16 11:48	GlutenFreeAdv Bella Gluten-Free biscuit mix is so good, I couldn't pass up their blueberry scone mix when I saw	GlutenFreeAdv Bella Gluten-Free	http://twitter.com/GlutenFreeAdv/statuses/
Ireland	08/23/16 17:30	AileenL_246 Comparing mass to a trip to the gym and having a gluten free biscuit. Gold! @👀👀👀👀👀👀	AileenL_246 Comparing mass to	http://twitter.com/AileenL_246/statuses/76

(c)

Appendix Figure 6. Sample for social media data sets. (a) Facebook sample; (b) Facebook sample; (c) Twitter sample. Source: Perspectory Media Insights, 2016-17.