

Chapman University

Chapman University Digital Commons

Food Science Faculty Articles and Research

Science and Technology Faculty Articles and
Research

11-5-2020

Bovine Liver Supplement Labeling Practices and Compliance With U.S. Regulations

Anthony J. Silva

Chapman University, silva130@mail.chapman.edu

Olive J. Dahm

Chapman University, dahm@chapman.edu

Rosalee S. Hellberg

Chapman University, hellberg@chapman.edu

Follow this and additional works at: https://digitalcommons.chapman.edu/food_science_articles



Part of the [Beef Science Commons](#), [Food Processing Commons](#), [Other Animal Sciences Commons](#), and the [Other Food Science Commons](#)

Recommended Citation

Anthony J. Silva, MS, Olive J. Dahm, MS & Rosalee S. Hellberg (2020) Bovine Liver Supplement Labeling Practices and Compliance With U.S. Regulations, *Journal of Dietary Supplements*, <https://doi.org/10.1080/19390211.2020.1834048>

This Article is brought to you for free and open access by the Science and Technology Faculty Articles and Research at Chapman University Digital Commons. It has been accepted for inclusion in Food Science Faculty Articles and Research by an authorized administrator of Chapman University Digital Commons. For more information, please contact laughtin@chapman.edu.

Bovine Liver Supplement Labeling Practices and Compliance With U.S. Regulations

Comments

This is an Accepted Manuscript of an article published in *Journal of Dietary Supplements* in 2020, available online at <https://doi.org/10.1080/19390211.2020.1834048>. It may differ slightly from the final version of record.

Copyright

Taylor & Francis

Bovine Liver Supplement Labeling Practices and Compliance with U.S. Regulations

Authors: Anthony J. Silva, Olive J. Dahm, and Rosalee S. Hellberg*

Chapman University, Schmid College of Science and Technology, Food Science Program, One University Drive, Orange, CA 92866

***Corresponding Author**

Rosalee S. Hellberg, Ph.D.

Phone: (714) 628-2811

Email: hellberg@chapman.edu

Disclosure of interest

Olive Dahm is employed at a dietary supplement manufacturing company. Anthony Silva and Rosalee Hellberg report no conflict of interest.

1 **Abstract**

2 Bovine liver supplements are sought after by consumers due to their nutrient-dense
3 profile and high protein content. However, there is a lack of information regarding bovine liver
4 supplement labeling practices. The objective of this study was to assess labeling practices and
5 compliance with U.S. regulatory standards among commercially sold bovine liver supplements.
6 The product labels for 49 bovine liver supplements were examined for required information,
7 including a statement of identity; net quantity of contents; “Supplement Facts” label; ingredient
8 statement; and name and place of business of manufacturer, packer, or distributor with domestic
9 address or telephone number. Any claims made on the supplement labels were also reviewed for
10 compliance. Overall, 59% of the products had at least one instance of noncompliance with U.S.
11 labeling regulations. The main categories of noncompliance were: missing a domestic mailing
12 address or phone number (39% of products), noncompliant nutrient content claim (31% of
13 products), and missing/noncompliant disclaimer for a nutritional support statement (6% of
14 products). The lack of a mailing address or phone number is problematic because it prevents
15 consumers from being able to report serious adverse events to the manufacturer. The majority
16 (85%) of the nutrient content observed on product labels were found to be noncompliant.
17 Noncompliant nutrient content claims are a major concern for consumers that rely on these
18 claims to assess the nutritional benefits of a product. Overall, the results of this study revealed a
19 lack of labeling compliance in bovine liver supplements, indicating a need for increased
20 awareness and monitoring.

21
22 **Keywords:** bovine liver; dietary supplements; labeling compliance; nutrient content claims;
23 structure/function claims

24 **1. Introduction**

25 Desiccated and defatted bovine liver is used as a dietary supplement due to its high
26 protein content, low caloric value, and nutrient dense profile (Kang et al., 2017). It is known to
27 contain numerous vitamins and minerals, including vitamins A and E; B vitamins (B1, B6, B12,
28 biotin, folate, and niacin); copper; iron; zinc; and omega-3 fatty acids (Duizer et al., 2017;
29 Fayemi et al., 2018). According to the Dietary Supplement Label Database, liver is the most
30 common animal tissue found in dietary supplements, with over 140 different products listing it as
31 an ingredient (NIH, 2019). The primary source of liver and other animal tissues in dietary
32 supplements is beef, followed by pork, sheep, and chicken (NIH, 2019). Previous studies have
33 reported mislabeling of dietary supplements, including shark cartilage (Isaacs and Hellberg,
34 2019); probiotic supplements (Morovic et al., 2016); and herbal products (Newmaster et al.,
35 2013). However, there is a lack of research on the labeling practices associated with bovine
36 (subfamily Bovidae) liver supplements and their compliance with U.S. regulations.

37 The Dietary Supplement Health and Education Act (DSHEA) of 1994 requires
38 manufacturing companies to evaluate the safety and labeling of their products prior to marketing
39 (FDA, 2020a). The U.S. Food and Drug Administration (FDA) investigates misbranded or
40 adulterated dietary supplement products that are sold in the marketplace. The failure of dietary
41 supplement companies to follow labeling regulations could result in an FDA warning letter, and
42 if the issue is not addressed, further regulatory action, including removal of the product from the
43 market (FDA, 2020b). U.S. regulations require that dietary supplement labels include a statement
44 of identity (“Dietary Supplement”), net quantity of contents, “Supplement Facts” label with
45 ingredients and allergen disclosures, and the name and place of business of the manufacturer,
46 packer, or distributor with a mailing address and/or telephone number (FDA, 2018). The

47 “Supplement Facts” label must include the name and quantity of dietary ingredients in the
48 product, the “Serving Size”, and the “Servings per Container.” However, the “Servings per
49 Container” is not required if it contains the same information shown in the net quantity of
50 contents. As is the case with conventional foods, dietary supplements must inform consumers of
51 the presence of any of the eight major allergens identified by the Food Allergen Labeling and
52 Consumer Protection Act of 2004.

53 Dietary supplement labels may also include claims, such as health claims, nutrient
54 content claims, and statements of nutritional support (FDA, 2018). Health claims must be based
55 on a recognized scientific connection between a substance and reduced risk of a disease or other
56 health-related condition and cannot be used unless they have been evaluated and authorized by
57 the FDA (FDA, 2020c). Nutrient content claims describe the levels of certain nutrients in a
58 product and have specific wording requirements defined in 21 CFR § 101. For example, a “Good
59 Source” claim can be used if the nutrient is present at 10-19% of the Reference Daily Intake
60 (RDI) or Daily Reference Value (DRV), both which are expressed on the label as the Percent
61 Daily Value (%DV). “High” claims can be used provided that the product contains 20% or more
62 of the RDI or DRV for the nutrient. Structure/function claims, which are a type of nutritional
63 support statement, explain the role of a nutrient intended to affect normal structure or function of
64 the human body. Structure/function claims are not permitted if a disease is mentioned or if it is
65 implied that the supplement will repair or treat any damage or dysfunctions in the body (FDA,
66 2020c). General well-being claims, which also fall under nutritional support statements, describe
67 how consuming a nutrient impacts the general well-being of an individual. Nutritional support
68 statements must be substantiated by competent and reliable scientific evidence and include a
69 disclaimer box stating: “This statement has not been evaluated by the Food and Drug

70 Administration. This product is not intended to diagnose, treat, cure, or prevent any disease”
71 (FDA, 1994; FTC, 2001; Levinson, 2012).

72 Dietary supplement mislabeling and/or adulteration has been reported in previous
73 research that detected undeclared ingredients (Cohen et al., 2014; Hellberg et al., 2019;
74 Newmaster et al., 2013), non-compliant labeling (Isaacs and Hellberg, 2019), and the use of
75 unsubstantiated claims (Avery et al., 2017; Isaacs and Hellberg, 2019; Levinson, 2012;
76 Schoonees et al., 2013). For example, one study assessed 29 shark cartilage dietary supplements
77 for compliance with U.S. labeling regulations and found that 48% of samples had at least one
78 instance of noncompliance, including noncompliant nutrient content claims and prohibited
79 disease claims (Isaacs and Hellberg, 2019). A study examining dietary supplement
80 advertisements circulating in various magazines from 2003-2009 in the U.S. found that many of
81 the structure/function claims mimicked health claims and were largely unsubstantiated by
82 clinical literature (Avery et al., 2017). In an analysis of 1,624 substantiation documents
83 voluntarily submitted to FDA by manufacturers for structure/function claims associated with
84 weight loss or immune system support, it was determined that only 34% of substantiation
85 documents were human studies and none met all of FDA’s recommendations for competent and
86 reliable evidence (Levinson, 2012).

87 While previous research has revealed concerns regarding labeling compliance and use of
88 unsubstantiated claims on dietary supplements, there is a lack of information specifically on
89 bovine liver dietary supplements. Bovine liver supplements are at-risk for noncompliant nutrient
90 content and nutritional support statements due to consumer expectations of a high-protein,
91 nutrient-dense product, as well as the associated health benefits. Therefore, the objective of this

92 study was to analyze the labeling practices and compliance with U.S. regulatory standards for
93 bovine liver dietary supplements sold in the United States.

94 **2. Materials and Methods**

95 *2.1 Sample collection*

96 Dietary supplement products (n = 49) claiming to contain beef or bovine liver originally
97 described in Dahm (2020) were examined in this study. The products were purchased from six
98 online sources available to U.S. consumers and were associated with 46 brand names and 44
99 manufacturers. The supplements were primarily in the form of hard gelatin or vegetarian
100 capsules (n = 40), while the remaining products consisted of tablets (n = 7), powders (n = 1), and
101 soft gelatin capsules (n = 1). Following collection, each product was photographed and labeled
102 with a specific sample number. The original sample set included 53 products; however, 4 of the
103 products were excluded from this study because they were marketed specifically for pets.

104 *2.2 Label analysis*

105 Each dietary supplement label was examined for the following required information:
106 statement of identity, net quantity of contents, “Supplement Facts” label, ingredient statements
107 with declared allergens (if applicable), and name and place of business of manufacturer, packer,
108 or distributor with domestic address or telephone number (21 CFR § 101 and 21 USC § 343). In
109 accordance with FDA supplement compliance, a domestic address is defined as including a full
110 mailing address (FDA, 2009).

111 All claims made on the labels, including general well-being claims, structure/function claims,
112 and nutrient content claims were recorded and identified for compliance with U.S. regulations
113 (21 CFR § 101 and 21 USC § 343). The wording of each claim was examined to ensure that only
114 permitted statements were used on the label. Products with structure/function claims or general

115 well-being claims were examined for the presence of the required disclaimer: “This statement
116 has (These statements have) not been evaluated by the Food and Drug Administration. This
117 product is not intended to diagnose, treat, cure, or prevent any disease” (21 CFR § 101.93).
118 Structure/function claims were also investigated for the presence of supporting scientific
119 evidence. However, the ability of the claim to meet the definition of substantiation was not
120 determined due to the possibility of additional evidence not available to the authors as well as the
121 need for the FDA to evaluate and make a determination on the claim. Product labels with
122 nutrient content claims were examined to ensure that the declared levels of nutrients were
123 appropriate in relation to the RDI or DRV (21 CFR § 101.54). Claims about the absence of a
124 specific ingredient or food component to facilitate the avoidance of the substance due to food
125 allergies, food intolerance, religious beliefs, or dietary practices were not considered to be
126 nutrient content claims (21 CFR § 101.65).

127 It should be noted that this study was limited to examination of the external components of
128 the label. Laboratory verification of factors such as the net quantity of contents, the presence of
129 allergens, country of origin, and nutrient content claims was not performed.

130 **3. Results**

131 Of the 49 bovine liver supplement labels examined in this study, 29 products (59%) had
132 at least one instance of noncompliance with U.S. labeling regulations (Table 1). A total of 97
133 instances of noncompliance were observed, with an average of 3 violations per noncompliant
134 product and a maximum of 16 violations in one product (sample no. 46). The lack of a domestic
135 mailing address or phone number was observed in 19 samples, followed by noncompliant
136 nutrient content claims in 15 samples, and missing/noncompliant disclaimers on 3 samples with
137 structure/function claims. Violations that were only observed in one sample include a prohibited

138 disease claim (no. 6), missing statement of identity (no. 42), missing “Supplement Facts” label
139 (no. 41), and missing name of manufacturer, packer, or distributor (no. 41). Interestingly, the
140 majority (n = 11) of the samples missing a domestic address or phone number instead listed a
141 website along with a city and state; 3 samples listed only the city and state; 3 listed only a
142 website; and 2 did not list a website or geographical location. Of note, only one sample (no. 3)
143 was declared to have been manufactured outside the United States and this sample was compliant
144 with the U.S. labeling regulations assessed in this study.

145 The majority (73.5%) of beef liver dietary supplement products contained at least one
146 type of claim examined in this study, with a total of 216 claims observed (Table 1). The most
147 common type of claim was structure/function (n = 108), followed by nutrient content (n = 84),
148 gluten-free (n = 21), general well-being (n = 2), and prohibited disease (n = 1). No health claims
149 were identified on any samples in this study. Among the 216 claims examined in this study, 72
150 claims (33%) were determined to be noncompliant with U.S. regulations. The most common
151 noncompliant claims were those associated with nutrient content (n = 71), followed by implied
152 prohibited disease claims (n = 1).

153 Structure/function claims were identified in 27 products (Table 1). These products had an
154 average of 4 structure/function claims each, with a maximum of 17 (no. 26). The most common
155 types of structure/function claims identified in this study were associated with providing energy,
156 vitality, stamina, and/or boosting metabolism (n = 30); supporting collagen synthesis and/or
157 healthy skin, hair, or nails (n = 20); supporting healthy liver function or detoxification (n = 10);
158 supporting immune health (n = 9); supporting heart health (n = 5); and supporting brain health (n
159 = 5) (Table 1). Less common structure/function claims included statements about supporting
160 hormone levels or mood (n = 4), healthy/strong bones or teeth (n = 4), digestive health (n = 3),

161 and joint health (n = 2). Two products (24, 33) included general well-being claims, with
162 statements including support for “overall health” and “for your good health”. While these claims
163 could also be interpreted as implied nutrient content claims for “healthy”, the intended purpose
164 of the claim appeared to be for general well-being. Three of the samples with structure/function
165 claims were found to be noncompliant for the required disclaimer: two used the abbreviated form
166 of FDA (nos. 15, 16) and one sample was missing a disclaimer (no. 9). Of note, 11 products
167 contained a disclaimer even though no structure/function or general well-being claims were
168 stated.

169 A prohibited disease claim was identified in one sample (no. 6), which had the statement
170 “the liver is involved in many significant body functions such as affording protection from
171 disease”. Although the preceding text (Table 1) implies that the statement refers to the human
172 liver, use of the phrase “protection from disease” on the dietary supplement label was determined
173 to be a prohibited disease claim because the consumer may translate normal organ function to a
174 perceived disease prevention (21 CFR § 101.93).

175 Nutrient content claims (n = 84) were present on the labels of 20 of the beef liver
176 supplement products, with a maximum of 15 claims on one product label (no. 46; Table 1).
177 Noncompliant nutrient content claims were observed on 15 of the product labels and only 7
178 products contained claims that were compliant with regulations, based on the information
179 provided on the label (21 CFR § 101.54; 21 CFR § 101.60; 21 CFR § 101.61). These products
180 claimed to be free of sodium (nos. 10, 18), free of salt (nos. 13, 18, 33), free of sugar (nos. 10,
181 18, 20, 33, 36), and/or an excellent source (containing 20% or more of the RDI) of vitamin B12
182 (nos. 10, 16). However, further laboratory testing would need to be conducted to confirm the
183 accuracy of these claims.

184 Most nutrient content claims (84.5%) were determined to be noncompliant. The most
185 common type of noncompliant nutrient content claim (n = 56) observed in this study listed a
186 nutrient that was associated with an RDI or DRV, but the label did not show the actual amount of
187 the nutrient in the product (FDA, 2018). The main nutrients associated with this type of
188 noncompliant claim included vitamin A (n = 9), vitamin B12 (n = 8), iron (n = 8), folate (n = 6),
189 choline (n = 5), copper (n = 5), zinc (n = 3), and protein (n = 4). In a few additional cases (n = 3),
190 the nutrient was listed on the “Supplement Facts” label, but the declared amount was not
191 sufficient to support the claim (i.e., 10-19% of the RDI or DRV for “good source” claims and
192 20% or more of the RDI or DRV for “high” claims). Nine samples made noncompliant nutrient
193 content claims by stating “source of”, “contains”, or “rich in” followed by dietary ingredients
194 without RDIs or DRVs, specifically hyaluronic acid (n = 5), amino acids (n = 4) and CoQ10 (n =
195 3). All 12 of these claims were determined to be noncompliant because the dietary ingredients
196 listed are not defined as nutrients by regulation (21 CFR 101.9).

197 “Gluten free” claims were identified in 21 products and were deemed compliant based on
198 the information on the label, as no ingredients known to contain gluten were listed. However,
199 further laboratory testing would be required to confirm the absence of gluten in these products.
200 Numerous statements were observed on supplement labels that indicated the absence of
201 genetically modified organisms (GMOs; n = 22), hormones (n = 22), dairy or milk (n = 19), soy
202 (n = 16), artificial colors or flavors (n = 15), wheat (n = 12), preservatives (n = 11), antibiotics (n
203 = 9), and pesticides (n = 9). Statements related to absence of dairy, soy, and wheat appeared to
204 focus on avoidance due to dietary preferences and were therefore not considered to be nutrient
205 content claims (21 CFR § 101.65). Label statements about substances that are nonnutritive or do
206 not have a nutritive function, such as “no preservatives” or “no artificial colors”, are also not

207 considered to be nutrient content claims and are not subject to the requirements of 21 CFR §
208 101.13 or 101.65.

209 **4. Discussion**

210 This study revealed noncompliance with U.S. labeling regulations in 59% of bovine liver
211 supplement products, with the major categories of noncompliance being the lack of a domestic
212 mailing address or phone number and noncompliant nutrient content claims. In comparison,
213 Isaacs and Hellberg (2019) reported a slightly lower rate of noncompliance (48.3%) for shark
214 cartilage dietary supplements, with the same top two categories of noncompliance as the current
215 study (i.e., noncompliant nutrient content claims and the lack of a domestic mailing address or
216 phone number). Overall, 98% of the products analyzed in the current study were compliant for a
217 statement of identity, “Supplement Facts” label, and name of manufacturer/packer/distributor. Of
218 the 19 products that were missing a domestic mailing address or phone number, 74% included a
219 website on the label (with or without a city and state). These findings indicate that some
220 manufacturers may be assuming that a website is an appropriate alternative to a domestic mailing
221 address or phone number for labeling purposes. However, without a domestic mailing address or
222 phone number on the label, the supplement is considered mislabeled (FDA, 2009). The lack of
223 this information on the label is a major concern because it removes the ability of the consumer to
224 report any serious adverse events associated with the product to the responsible person.

225 Among the dietary supplements examined in this study, a total of 108 structure/function
226 claims and 2 general well-being claims were observed. Structure/function claims “describe the
227 role of a nutrient or dietary ingredient intended to affect the structure or function of the human
228 body,” or “characterize the means by which a nutrient or dietary ingredient acts to maintain such
229 structure or function”, while general well-being claims “describe general well-being from

230 consumption of a nutrient or dietary ingredient” (FDA, 2017). However, most structure/function
231 claims (85%) and the two well-being claims examined in this study did not specify the nutrient
232 or dietary ingredient associated with the claim. Examples include statements such as “Energy
233 and Stamina” (no. 4), “For the support of healthy liver function” (no. 14); and “Supports: energy
234 levels, fat metabolism, muscle building, exercise recovery, brain and heart health” (no. 30). In an
235 additional three products (nos. 16, 17, and 33), the dietary ingredient associated with the claim
236 was “liver”, although the claims were likely based on scientific evidence associated with specific
237 nutrients in liver. For example, claims made by samples 17 and 33 associated with energy were
238 likely due to the presence of iron in the liver supplement. Not specifying the nutrient or dietary
239 ingredient associated with a structure/function or well-being claim is of concern because this
240 makes it difficult for consumers to determine the basis for the claim.

241 While structure/function claims were not evaluated for substantiation in this study due to
242 the possibility of additional evidence not available to the authors as well as the need for the FDA
243 to evaluate the claim, the available scientific evidence for each claim was reviewed. A variety of
244 structure/function claims were observed on bovine supplement labels, with the most common
245 being those associated with boosting energy, vitality, stamina, and/or metabolism. Numerous
246 claims were also associated with supporting collagen synthesis and/or healthy skin, hair, or nails;
247 supporting healthy liver function or detoxification; supporting immune health; supporting heart
248 health; and supporting brain health. Because bovine liver is known to contain many essential
249 nutrients, most of the claims appeared to be associated with scientific evidence on specific
250 nutrients in bovine liver. For example, scientific evidence is available that supports a link
251 between energy levels and certain nutrients in bovine liver, including vitamin B12, iron, and zinc
252 (Tardy et al., 2020). Skin health has also been scientifically linked to specific nutrients in bovine

253 liver, including vitamins D and E (Schagen et al., 2012). Cutaneous abnormalities involving the
254 hair, skin, and nails have been associated with deficiencies in many of the micronutrients found
255 in bovine liver, including niacin, biotin, vitamins B12, A, and B; zinc; iron; and copper (DiBaise
256 and Tarleton, 2019). In regard to collagen synthesis, there is a well-established relationship
257 between nutrient intake and wound healing, however, it is unclear as to whether administration
258 of specific nutrients can lead to enhanced collagen synthesis (Albaugh et al., 2017). Immune
259 function has been linked to many of the nutrients in bovine liver, including vitamins A, B6,
260 folate, B12, D, and E; iron; copper; and zinc (Wintergerst et al., 2007). Regarding heart and liver
261 health, vitamin D deficiencies have been linked to cardiovascular heart disease and nonalcoholic
262 fatty liver disease (Hariri and Zohdi, 2019; Holick, 2005). As for brain function, there is
263 scientific evidence that supports a link between B vitamins, such as B12 and folate, and brain
264 health (Kennedy, 2016).

265 Some of the less common structure/function claims observed in the bovine liver
266 supplements included those associated with supporting hormone levels or mood, healthy/strong
267 bones or teeth, digestive health, and joint health. Many of these claims are related to scientific
268 studies on individual nutrients that are found in bovine liver. For example, hormone levels and
269 mood have been reported to be associated with consumption of B vitamins, including folate, B6,
270 and B12 (Kaplan et al., 2007; Rose, 1978). Claims related to healthy/strong bones and teeth are
271 associated with vitamin D intake (Holick, 1996; Jimenez et al., 2014). While a relationship has
272 been reported between vitamin D deficiency and inflammatory bowel disease, the role of vitamin
273 D in promoting digestive health is not well established (Del Pinto et al., 2015). Joint health may
274 be associated with some of the vitamins and minerals in bovine liver, such as vitamin D and zinc,

275 for example in the management of knee osteoarthritis (Hafsi et al., 2019; McAlindon et al.,
276 2013).

277 Despite the presence of scientific research linked to nutrients in bovine liver, it is
278 important to note that this does not necessarily mean that the structure/function claims made on
279 the supplement labels would be considered substantiated by the FDA. In order for a claim to be
280 substantiated, competent and reliable scientific evidence demonstrating a direct effect of the
281 supplement or its active ingredients on a structure or function of the body must be established
282 (Levinson, 2012). If the evidence is based on an active ingredient, the amount or potency of that
283 ingredient should be similar to what is found in the supplement product. FDA recommends that
284 the scientific evidence used to substantiate the claim be derived primarily from human studies
285 using scientific methods that are widely accepted. Supporting evidence, such as meta-analyses,
286 animal studies, and review articles, may be used to help substantiate claims; however, this type
287 of information may not be sufficient when used alone. Studies that focus on treatment of diseases
288 are not considered to be consistent with FDA guidance on substantiation because they raise
289 questions about the intended meaning of the claim (Levinson, 2012). The inability to determine
290 whether the structure/function claims observed for bovine liver supplements would be
291 considered substantiated by FDA was a limiting factor for assessing compliance in this study.

292 The percentage of products with structure/function or general well-being claims that had
293 an absent or noncompliant disclaimer (11%) is similar to a previous study on weight loss or
294 immune support dietary supplements (7%) (Levinson, 2012), yet lower than that reported by
295 Isaacs and Hellberg (2019) for shark cartilage products (31.3%). In regard to prohibited disease
296 claims, this study identified a low rate (2%) of these claims compared to previous studies (14-
297 20%) (Isaacs and Hellberg, 2019; Levinson, 2012). The occurrence of prohibited disease claims

298 and structure/function claims without the required disclaimer is a public health concern because
299 it could cause confusion among consumers and delay or prevent them from seeking professional
300 diagnosis and treatment for a disease.

301 Overall, 30.6% of products contained noncompliant nutrient content claims. These
302 findings are similar to a previous study analyzing shark cartilage dietary supplements, which
303 reported 28% of products had a noncompliant nutrient content or implied nutrient content claim
304 (Isaacs and Hellberg, 2019). Out of the 84 nutrient content claims in this study, 71 (84.5%) were
305 noncompliant, largely because the amount of the essential nutrient was not listed on the label.
306 Noncompliant nutrient labeling is problematic for consumers that rely on the claims to determine
307 the nutritional benefits of a product. For example, if the amount of a nutrient is not listed on the
308 supplement label, consumers are unable to assess whether "Good Source" or "High" claims are
309 accurate. Noncompliant nutrient content claims identified in this study that used terms such as
310 "source of" or "rich in" followed by a nutrient without an RDI or DRV may be confusing or
311 misleading for consumers, who may be led to believe that the nutrient in the claim is considered
312 essential. For example, one product (no. 26) claimed to be "rich in...CoQ10"; however, the
313 inclusion of a non-essential nutrient (CoQ10) with the term "rich" is a non-compliant nutrient
314 content claim. It is important to note that the lack of laboratory analysis for gluten-free and
315 nutrient content claims limited the scope for compliance assessment in this study.

316 Certain samples in this study included the terms "nutrient dense" (n = 6), "nutrient rich"
317 (n = 3), and/or "rich source of nutrients" (n = 1), which are not specifically referred to in U.S.
318 regulations. According to the Dietary Guidelines for Americans, "nutrient dense foods provide
319 vitamins, minerals, and other substances that contribute to adequate nutrient intakes"
320 (Blankenship and Tuma, 2017). While bovine liver is known to contain a number of nutrients

321 (Fayemi et al., 2018), none of the samples in this study using the terms “nutrient dense”,
322 “nutrient rich”, or “rich source of nutrients” listed specific vitamins or minerals in the
323 “Supplement Facts” label.

324 **5. Conclusion**

325 Overall, this study revealed that 59% of beef liver supplement labels examined had at
326 least one instance of noncompliance with U.S. labeling regulations. The main noncompliance
327 items identified included: missing a domestic mailing address or phone number, noncompliant
328 nutrient content claims, and missing/noncompliant disclaimer related to structure/function
329 claims. The lack of a domestic mailing address or phone number on over one-third of products is
330 a major concern, as this prevents consumers from being able to report serious adverse events
331 associated with the supplement to the responsible person. Noncompliant nutrient content claims
332 on bovine liver supplements are problematic because they can misinform consumers and
333 negatively impact consumer health. Consumers that depend on these claims to assess the
334 nutritional benefits of a product may be misled by claims associated with nonessential nutrients
335 or claims that cannot be verified based on the information on the label. Furthermore, the lack a
336 disclaimer associated with structure/function claims may delay consumers from seeking
337 professional treatment for medical disorders.

338 **6. Acknowledgments**

339 This work was supported by internal funding from Chapman University Schmid College of
340 Science and Technology.

341

342

343

344 **7. References**

- 345 Albaugh, V.L., Mukherjee, K., Barbul, A., 2017. Proline Precursors and Collagen Synthesis:
346 Biochemical Challenges of Nutrient Supplementation and Wound Healing. *J Nutr* 147,
347 2011–2017.
- 348 Avery, R.J., Eisenberg, M.D., Cantor, J.H., 2017. An examination of structure-function claims in
349 dietary supplement advertising in the U.S.: 2003–2009. *Preventive Medicine* 97, 86–92.
- 350 Blankenship, J., Tuma, P., 2017. Academy comments to FDA re the definition of the “healthy”
351 nutrient content claim. URL [https://www.eatrightpro.org/news-center/on-the-pulse-of-](https://www.eatrightpro.org/news-center/on-the-pulse-of-public-policy/regulatory-comments/academy-comments-to-fda-re-the-definition-of-the-healthy-nutrient-content-claim)
352 [public-policy/regulatory-comments/academy-comments-to-fda-re-the-definition-of-the-](https://www.eatrightpro.org/news-center/on-the-pulse-of-public-policy/regulatory-comments/academy-comments-to-fda-re-the-definition-of-the-healthy-nutrient-content-claim)
353 [healthy-nutrient-content-claim](https://www.eatrightpro.org/news-center/on-the-pulse-of-public-policy/regulatory-comments/academy-comments-to-fda-re-the-definition-of-the-healthy-nutrient-content-claim) (accessed 6.22.20).
- 354 Cohen, P.A., Maller, G., DeSouza, R., Neal-Kababick, J., 2014. Presence of banned drugs in
355 dietary supplements following FDA recalls. *JAMA* 312, 1691–1693.
- 356 Del Pinto, R., Pietropaoli, D., Chandar, A.K., Ferri, C., Cominelli, F., 2015. Association between
357 Inflammatory Bowel Disease and Vitamin D deficiency: A systematic review and meta-
358 analysis. *Inflammatory Bowel Diseases* 21, 2708–2717.
- 359 DiBaise, M., Tarleton, S.M., 2019. Hair, nails, and skin: Differentiating cutaneous
360 manifestations of micronutrient deficiency. *Nutrition in Clinical Practice* 34, 490–503.
- 361 Duizer, L.M., Diana, A., Rathomi, H.S., Luftimas, D.E., Rahmannia, S., Santi, W., Nugraha,
362 G.I., Haszard, J.J., Gibson, R.S., Houghton, L.A., 2017. An acceptability trial of
363 desiccated beef liver and meat powder as potential fortifiers of complementary diets of
364 young children in Indonesia. *Journal of Food Science* 82, 2206–2212.

365 Fayemi, P.O., Muchenje, V., Yetim, H., Ahhmed, A., 2018. Targeting the pains of food
366 insecurity and malnutrition among internally displaced persons with nutrient synergy and
367 analgesics in organ meat. *Food Research International* 104, 48–58.

368 FDA, 1994. Dietary Supplement Health and Education Act of 1994. URL
369 https://ods.od.nih.gov/About/DSHEA_Wording.aspx (accessed 6.3.20).

370 FDA, 2009. Guidance for industry: questions and answers regarding the labeling of dietary
371 supplements as required by the Dietary Supplement and Nonprescription Drug Consumer
372 Protection Act. *Federal Register*. URL
373 [https://www.federalregister.gov/documents/2009/09/01/E9-21094/guidance-for-industry-
374 questions-and-answers-regarding-the-labeling-of-dietary-supplements-as](https://www.federalregister.gov/documents/2009/09/01/E9-21094/guidance-for-industry-questions-and-answers-regarding-the-labeling-of-dietary-supplements-as) (accessed
375 5.11.20).

376 FDA, 2017. Structure/Function Claims. FDA. URL [https://www.fda.gov/food/food-labeling-
377 nutrition/structurefunction-claims](https://www.fda.gov/food/food-labeling-nutrition/structurefunction-claims) (accessed 9.21.20).

378 FDA, 2018. Dietary Supplement Labeling Guide. FDA. URL [https://www.fda.gov/food/dietary-
379 supplements-guidance-documents-regulatory-information/dietary-supplement-labeling-
380 guide](https://www.fda.gov/food/dietary-supplements-guidance-documents-regulatory-information/dietary-supplement-labeling-guide) (accessed 5.11.20).

381 FDA, 2020a. Dietary Supplements. FDA. URL <https://www.fda.gov/food/dietary-supplements>
382 (accessed 5.11.20).

383 FDA, 2020c. Compliance & Enforcement (Food). FDA. URL
384 <https://www.fda.gov/food/compliance-enforcement-food> (accessed 5.11.20).

385 FDA, 2020b. Label claims for conventional foods and dietary supplements. FDA. URL
386 [https://www.fda.gov/food/food-labeling-nutrition/label-claims-conventional-foods-and-
387 dietary-supplements](https://www.fda.gov/food/food-labeling-nutrition/label-claims-conventional-foods-and-dietary-supplements) (accessed 5.11.20).

388 FTC, 2001. Dietary Supplements: An advertising guide for industry. Federal Trade Commission.
389 URL <https://www.ftc.gov/tips-advice/business-center/guidance/dietary-supplements->
390 [advertising-guide-industry](https://www.ftc.gov/tips-advice/business-center/guidance/dietary-supplements-advertising-guide-industry) (accessed 5.11.20).

391 Hafsi, K., McKay, J., Li, J., Lana, J.F., Macedo, A., Santos, G.S., Murrell, W.D., 2019.
392 Nutritional, metabolic and genetic considerations to optimise regenerative medicine
393 outcome for knee osteoarthritis. *Journal of Clinical Orthopaedics and Trauma,*
394 *Regenerative Medicine for Knee Osteoarthritis* 10, 2–8.

395 Hariri, M., Zohdi, S., 2019. Effect of vitamin D on non-alcoholic fatty liver disease: A
396 systematic review of randomized controlled clinical trials. *Int J Prev Med* 10.

397 Hellberg, R.S., Isaacs, R.B., Hernandez, E.L., 2019. Identification of shark species in
398 commercial products using DNA barcoding. *Fisheries Research* 210, 81–88.

399 Holick, M.F., 1996. Vitamin D and bone health. *J Nutr* 126, 1159S-1164S.

400 Holick, M.F., 2005. Vitamin D: important for prevention of osteoporosis, cardiovascular heart
401 disease, type 1 diabetes, autoimmune diseases, and some cancers. *Southern Medical*
402 *Journal* 98, 1024–1028.

403 Isaacs, R.B., Hellberg, R.S., 2019. Shark cartilage supplement labeling practices and compliance
404 with U.S. regulations. *Journal of Dietary Supplements* 5, 1–13.

405 Jimenez, M., Giovannucci, E., Kaye, E.K., Joshipura, K.J., Dietrich, T., 2014. Predicted vitamin
406 D status and incidence of tooth loss and periodontitis. *Public Health Nutrition* 17, 844–
407 852.

408 Kang, S.-W., Kim, H.-M., Rahman, M.S., Kim, A.-N., Yang, H.-S., Choi, S.-G., 2017.
409 Nutritional quality and physicochemical characteristics of defatted bovine liver treated by

410 supercritical carbon dioxide and organic solvent. *Korean J Food Sci Anim Resour* 37,
411 29–37.

412 Kaplan, B.J., Crawford, S.G., Field, C.J., Simpson, J.S.A., 2007. Vitamins, minerals, and mood.
413 *Psychological bulletin* 133, 747–760.

414 Kennedy, D.O., 2016. B vitamins and the brain: mechanisms, dose and efficacy—A review.
415 *Nutrients* 8, 68.

416 Levinson, D., 2012. Dietary Supplements: Structure/Function claims fail to meet federal
417 requirements (OEI-01-11-00210; 10/12). *Dietary Supplements* 31.

418 McAlindon, T., LaValley, M., Schneider, E., Nuite, M., Lee, J.Y., Price, L.L., Lo, G., Dawson-
419 Hughes, B., 2013. Effect of Vitamin D Supplementation on Progression of Knee Pain and
420 Cartilage Volume Loss in Patients With Symptomatic Osteoarthritis: A Randomized
421 Controlled Trial. *JAMA* 309, 155–162.

422 Morovic, W., Hibberd, A.A., Zabel, B., Barrangou, R., Stahl, B., 2016. Genotyping by PCR and
423 High-Throughput Sequencing of commercial probiotic products reveals composition
424 biases. *Front Microbiol* 7, 1747.

425 Newmaster, S.G., Grguric, M., Shanmughanandhan, D., Ramalingam, S., Ragupathy, S., 2013.
426 DNA barcoding detects contamination and substitution in North American herbal
427 products. *BMC Medicine* 222, 18–35.

428 NIH, 2019. Dietary Supplement Label Database (DSLDD). URL
429 <https://www.dsld.nlm.nih.gov/dsld/index.jsp> (accessed 5.11.20).

430 Rose, D.P., 1978. The interactions between vitamin B6 and hormones. *Vitamins and Hormones*
431 36, 53–99.

432 Schagen, S.K., Zampeli, V.A., Makrantonaki, E., Zouboulis, C.C., 2012. Discovering the link
433 between nutrition and skin aging. *Dermatoendocrinol* 4, 298–307.

434 Schoonees, A., Young, T., Volmink, J., 2013. The advertising of nutritional supplements in
435 South African women’s magazines: a descriptive survey. *South African Journal of*
436 *Clinical Nutrition* 26, 12–18.

437 Tardy, A.-L., Pouteau, E., Marquez, D., Yilmaz, C., Scholey, A., 2020. Vitamins and minerals
438 for energy, fatigue and cognition: A narrative review of the biochemical and clinical
439 evidence. *Nutrients* 12, 228.

440 Wintergerst, E.S., Maggini, S., Hornig, D.H., 2007. Contribution of selected vitamins and trace
441 elements to immune function. *Annals of Nutrition & Metabolism; Basel* 51, 301–23.

442

Table 1: Labeling practices and compliance information for bovine liver dietary supplement labels examined in this study (n = 49). Instances of noncompliance are shown with gray shading. All products were compliant with allergen declarations and net quantity of contents.

Sample	Statement of identity	Claims and other relevant wording on label	Claim type ^a	Disclaimer	“Supplement Facts” label	Domestic mailing address or telephone number	Name of manufacturer/ packer/ distributor	Instances of noncompliance
1	Compliant	Pesticide and herbicide free.	N/A	Not present	Compliant	Compliant	Compliant	0
2	Compliant	Natural source of high-quality protein, amino acids, vitamin A, B vitamins, and iron. Hormone Free. Non-GMO. Gluten Free. No Chemicals. No Dairy.	GF; NC(5)	Present (not required)	Compliant	Compliant	Compliant	5
3	Compliant	Without the use of growth hormones, antibiotics, chemicals or GMOs.	N/A	Present (not required)	Compliant	Compliant	Compliant	0
4	Compliant	Energy and Stamina. Reduces gastric upset, nausea, and constipation associated with iron supplementation. Contains soy. Gluten free. No yeast, wheat, dairy products, artificial flavors or preservatives.	GF; S/F(5)	Present	Compliant	Compliant	Compliant	0
5	Compliant	Freeze-dried to keep the full range of immune-boosting nutrients intact and undamaged. Non-GMO. Soy, Gluten, Grain, and Dairy free. Never fed grains or given antibiotics or hormones.	GF; S/F(1)	Present	Compliant	Compliant	Compliant	0
6	Compliant	The liver is one of the largest organs. It is located in the upper right abdomen immediately under the diaphragm and attached to it by ligaments. The liver is involved in many significant body functions such as affording protection from disease, supplying blood sugar to meet the needs of muscle tissue, and regulating the clotting of blood. Contains no yeast, soy, starch, wheat, gluten, rye, rice, corn, dairy products, preservatives or artificial coloring.	GF; PDC(1)	Present (not required)	Compliant	Compliant	Compliant	1

7	Compliant	Contains a full spectrum of amino acids as well as other necessary and essential nutrients found only in the liver. Contains milk and soy. Hormone-free cattle.	NC(1)	Present (not required)	Compliant	Compliant	Compliant	1
8	Compliant	Hypoallergenic	N/A	Not present	Compliant	Compliant	Compliant	0
9	Compliant	Supports healthy liver function ^b . This product is gluten and dairy free.	GF; S/F(1)	Not present	Compliant	Compliant	Compliant	1
10	Compliant	Free of gluten, wheat, dairy, soy, yeast, sugar, sodium, artificial flavors, preservatives and color. An excellent source of vitamin B-12. Hormone free.	GF; NC(3)	Not present	Compliant	Compliant	Compliant	0
11	Compliant	Provides a naturally occurring source of protein, vitamin B, and iron. No GMOs, pesticides, or chemicals.	NC(3)	Present (not required)	Compliant	Compliant	Compliant	3
12	Compliant	Natural source of iron. Supports energy metabolism. Does not contain pesticides, hormones, gluten, soy, or dairy. Non-GMO.	GF; NC(1); S/F(1)	Present	Compliant	Not provided	Compliant	2
13	Compliant	Designed to provide natural stress relief utilizing B-Complex, Citrus Bioflavonoids along with rice bran concentrate and Hepatrin complex for improved absorption. Sustained release to ensure maximum effectiveness. Free of artificial flavor & color, dairy, preservatives, salt, soy, gluten, starch, and wheat.	GF; NC(1); S/F(1)	Present	Compliant	Compliant	Compliant	0
14	Compliant	For the support of healthy liver function. Non-GMO. Not manufactured with yeast, wheat, gluten, soy, corn, milk, egg, fish, shellfish or tree nut ingredients. Free of additives and hormones.	S/F(1)	Present	Compliant	Compliant	Compliant	0
15	Compliant	Nutrient rich super food, full of naturally occurring vitamins and minerals. Helps boost energy levels, immune system, and improves skin health. Hormone, pesticide, and GMO	GF; S/F(3)	Non-compliant wording	Compliant	Not provided	Compliant	2

		free. No preservatives, colors, artificial flavors. Gluten-free.						
16	Compliant	Muscle support. Nutrient-dense source of high-quality protein. Over 60% protein, this high iron food concentrate is a comprehensive and complete protein. The beef liver is intended to provide nutritive support to build and maintain healthy muscles. As an excellent source of vitamin B-12 and iron, beef liver helps build healthy red blood cells.	NC(2); NC(1); S/F(2)	Non-compliant wording	Compliant	Compliant	Compliant	3
17	Compliant	Nutrient dense super food. Liver is one of the best kept secrets for energy and performance. Positive effects felt by virtually everyone who eats it. Our liver is always pasture raised, hormone free, antibiotic free. Liver is rich in bioavailable vitamin A, B12, CoQ10, iron, folate, zinc, & much more.	NC (6); S/F(2)	Present	Compliant	Not provided	Compliant	7
18	Compliant	Supports energy and metabolism. Natural and nutrient rich. Non-GMO. Contains no artificial coloring, artificial flavor, preservatives, salt, sodium, soy, sugar, gluten, starch, or wheat.	GF; NC(3); S/F(2)	Present	Compliant	Compliant	Compliant	0
19	Compliant	Hypoallergenic.	N/A	Not present	Compliant	Compliant	Compliant	0
20	Compliant	Hormone and GMO-free cows. A super-food that supports heart, brain, and liver health. Free of GMOs, gluten, dairy, sugar, soy, allergens, artificial colors, artificial flavors, artificial preservatives, FD&C synthetic dyes and added sugars.	GF; NC(1) S/F(3)	Present	Compliant	Compliant	Compliant	0
21	Compliant	Gluten and dairy free	GF	Not present	Compliant	Compliant	Compliant	0
22	Compliant	Contains bioavailable forms of vitamins A, B12, D3, and heme iron. Support optimal hormonal levels. Aid liver detoxification. Improve mood and energy. Follows the principle that the nutrients, enzymes, and other	GF; NC(4); S/F(4)	Present	Compliant	Compliant	Compliant	4

active factors present in healthful organs can be effective in revitalizing the same target organ that is depleted. Free of gluten, soy, dairy, and GMOs.

23	Compliant	Essential traditional superfoods. 100% additive free. GMO free. Without the use of pesticides, hormones or antibiotics. Hypoallergenic.	N/A	Present (not required)	Compliant	Not provided	Compliant	1
24	Compliant	One of nature's most powerful superfoods. Supports energy levels, immune function, and overall health and vitality. Hormone free. GMO free.	GW(1); S/F(3)	Present	Compliant	Compliant	Compliant	0
25	Compliant	Supports digestive health. Weight loss support. Natural liver detox. Optimal energy supplement.	S/F(4)	Present	Compliant	Not provided	Compliant	1
26	Compliant	This powerful potent superfood is rich in Vitamin A, B12, CoQ10, Zinc, Copper, Folate, Choline and Hyaluronic Acid. Promotes healthy skin, hair, nails, teeth and gum. Supports strong joints, connective tissue, and healthy collagen. Promotes strong immune and digestive system. Supports good energy, mood, and metabolism. Enhances brain, heart, and liver health. Rejuvenate the body. Hormone, pesticide, and GMO free.	NC(8); S/F(17)	Present	Compliant	Compliant	Compliant	8
27	Compliant	Nutrient dense superfood. Great for: skin health, joint health, immune support, energy support. Beef liver is known to be extremely rich in vitamins, minerals, and amino acids. 100% free of hormones, pesticides, gluten & GMO. Not manufactured with wheat, gluten, milk, egg, fish, shellfish or tree nut ingredients.	GF; NC(1); S/F(4)	Present	Compliant	Not provided	Compliant	2
28	Compliant	Support vital metabolic functions in the body and target healthy liver function with beef liver capsules that are rich in Vitamin A and B vitamins. Benefits of this energy boosting	NC(2); S/F(7)	Present	Compliant	Compliant	Compliant	2

superfood include organ health, immune support, healthy skin and bones, and balanced metabolism. Nourish and invest in your health. Without the use of harmful antibiotics, hormones, or pesticides. 100% additive-free.

29	Compliant	Optimal Energy Supplement	S/F(1)	Present	Compliant	Not provided	Compliant	1
30	Compliant	Nature's most potent superfood. Supports: energy levels, fat metabolism, muscle building, exercise recovery, brain and heart health. Rich in high-quality protein, Vitamin A, B12, folic acid, and most absorbable form of iron. Hormone, pesticide, gluten, and GMO free.	GF; NC(5); S/F(6)	Present	Compliant	Not provided	Compliant	6
31	Compliant	N/A	N/A	Not present	Compliant	Compliant	Compliant	0
32	Compliant	No added wheat, starch, yeast, gluten, corn, soy, sugar, artificial coloring or flavoring, antimicrobial preservatives or dairy products	N/A	Not present	Compliant	Compliant	Compliant	0
33	Compliant	Concentrated liver for energy and stamina. For your good health. Liver is a superior source of heme iron and other blood building nutrients. Non-GMO. No sugar, salt, yeast, wheat, gluten, corn, soy, dairy products, artificial coloring, artificial flavoring, or artificial preservatives.	GF; GW(1); NC(3); S/F(2)	Present	Compliant	Compliant	Compliant	0
34	Compliant	Beef liver is a high-quality superfood. Provides an abundant number of micronutrients including B12, copper, folate, choline, and hyaluronic acid, which have been shown to support the body's immune system, healthy skin, hair and nails, as well as, strong bones and collagen synthesis. Helps improve collagen and protein metabolism. Helps improve overall energy levels. 100% additive free. Non-GMO, dairy free, gluten free.	GF; NC(5); S/F(8)	Present	Compliant	Not provided	Compliant	6
35	Compliant	100% additive free. Hormone, pesticide, and GMO free	N/A	Present (not required)	Compliant	Not provided	Compliant	1

36	Compliant	This ancient nutritional powerhouse plays a fundamental role in supporting healthy skin, eyes, metabolism, immune function, strong bones, and collagen synthesis. Liver is an abundant source of nutrients, including vitamin B-12, folate, choline, copper, hyaluronic acid, and is one of the most concentrated sources of preformed vitamin A (retinol). Contains no dairy, wheat, yeast, gluten, corn, sugar, soy, shellfish, tree nuts, or preservatives.	GF; NC(1); NC(6); S/F(6)	Present	Compliant	Not provided	Compliant	7
37	Compliant	Optimal energy supplement. Liver support.	S/F(2)	Present	Compliant	Not provided	Compliant	1
38	Compliant	Optimal energy supplement. Liver support.	S/F(2)	Present	Compliant	Not provided	Compliant	1
39	Compliant	Nature's most potent superfood. Nature's most concentrated source of Vitamin A. Rich in Vitamin B12, folate, copper, hyaluronic acid, choline, and amino acids. It supports energy levels, brain health, digestive system health, liver function, and heart health. Provides essential nutrients for healthy skin, hair, and nails. Hormone and GMO-free	NC(7); S/F(8)	Present	Compliant	Compliant	Compliant	7
40	Compliant	No gluten, wheat, yeast, milk, lactose, soy, artificial color, artificial flavor, artificial sweetener, preservatives. Non-GMO.	GF	Not present	Compliant	Compliant	Compliant	0
41	Compliant	N/A	N/A	Not present	Not provided	Not provided	Not Provided	3
42	Not Provided	No hormones or additives. Pesticide free.	N/A	Not present	Compliant	Not provided	Compliant	2
43	Compliant	Delivers the natural nutrient profile found in the nutrient-dense whole foods. A rich source of nutrients. Traditional superfood. Additive-free. Free of pesticides and antibiotics.	N/A	Present (not required)	Compliant	Compliant	Compliant	0
44	Compliant	Free of pesticides, growth hormones, antibiotics, or chemical additives. Made	GF	Present (not required)	Compliant	Not provided	Compliant	1

without sugar, starch, preservatives, artificial colors or flavorings, or genetically modified organisms. Contains no yeast, no soy, no milk derivatives, no wheat and is gluten free.

45	Compliant	Contains no preservatives or binders. Gluten free, casein free.	GF	Present (not required)	Compliant	Compliant	Compliant	0
46	Compliant	Natural whole food vitamin and mineral support. One of nature's most nutrient rich superfoods. Liver is a nutritional powerhouse, abundant in vitamins and minerals and hyaluronic acid. Contains vitamins A, D, E, K2, B12, B3, B5, B6, and vital minerals like zinc, iron, copper, potassium, CoQ10 and choline for brain health.	NC(15); S/F(1)	Present	Compliant	Not provided	Compliant	16
47	Compliant	Liver is believed to contain more nutrients gram for gram than any other food. Delivers the natural nutrient profile found in nutrient-dense whole foods. Additive free. Free of pesticides and antibiotics.	N/A	Present (not required)	Compliant	Compliant	Compliant	0
51	Compliant	Grass-fed liver is the most nutrient dense superfood on the planet. The vitamins and minerals within support: skin, hair & nails, energy & stamina, thyroid health & metabolism, heart health, iron levels, hormonal production, immune function. Hormone free. Non-GMO.	S/F (11)	Present	Compliant	Not provided	Compliant	1
53	Compliant	No GMOs, pesticides, antibiotics, and hormones	N/A	Not present	Compliant	Not provided	Compliant	1

^aGF = gluten-free claim; GW = general well-being claim; N/A = not applicable (no claim or relevant wording on label); NC = nutrient content claim; PDC = prohibited disease claim S/F = structure/function claim. The number of NC and/or S/F claims for each product is shown in parentheses.

^bS/F claim included on a barcode sticker found on the product container.