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Abstract: Consumption of oat and buckwheat have been associated with various health benefits that may be attributed to their nutritional composition. We performed a systematic review to evaluate the profile and quantity of bioactive compounds present in oat and buckwheat. Among 154 studies included in final analysis, 113 and 178 bioactive compounds were reported in oat and buckwheat, respectively. Total phytosterols, tocots, flavonoids and rutin content were generally higher in buckwheat, β -glucans were significantly higher in oat, while avenanthramides and saponins were characteristically present in oat. The majority of studies included in current review were published before 2010s. The heterogeneous methodological procedures used across the studies precluded our possibility to meta-analyse the evidence and raises the need for harmonization of separation and extraction methods in future studies. Our findings should further stimulate the exploration of metabolites related to identified phytochemicals and their roles in human health

Highlights

- Oat and buckwheat are good sources of micro- and macronutrients and bioactive phytochemicals, with 113 and 178 phytochemicals reported respectively.
- Compared to oat, total phytosterols, tocots, flavonoids and rutin content were generally higher in buckwheat.
- β -glucans were significantly higher in oat while avenanthramides and saponins were characteristically found in oat.
- Proper food transformation might be a prerequisite to preserve nutritional content of oat and buckwheat.
- Bioactivity and bioavailability of oat and buckwheat's phytochemicals and their health effects need further investigation.

1 A Systematic Review of Phytochemicals in Oat and Buckwheat

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22

23 ABSTRACT

24

25 Consumption of oat and buckwheat have been associated with various health benefits that may be
26 attributed to their nutritional composition. We performed a systematic review to evaluate the profile
27 and quantity of bioactive compounds present in oat and buckwheat. Among 154 studies included in
28 final analysis, 113 and 178 bioactive compounds were reported in oat and buckwheat, respectively.
29 Total phytosterols, tocots, flavonoids and rutin content were generally higher in buckwheat, β -glucans
30 were significantly higher in oat, while avenanthramides and saponins were characteristically present in
31 oat. The majority of studies included in current review were published before 2010s. The
32 heterogeneous methodological procedures used across the studies precluded our possibility to meta-
33 analyse the evidence and raises the need for harmonization of separation and extraction methods in
34 future studies. Our findings should further stimulate the exploration of metabolites related to
35 identified phytochemicals and their roles in human health.

36

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39 1. INTRODUCTION

40 Cereal grains are the major source of energy and an important constituent of diet for millions of people
41 worldwide (Gangopadhyay, *et al.*, 2015); however, the majority of acreage dedicated to growing cereal
42 crops throughout the world produce wheat, rice, and maize (Food and Agriculture Organization, 2003).
43 This translates into consumption patterns that favor these crops over the other cereals, such as oat
44 (*Avena sativa L*) and buckwheat (*Fagopyrum esculentum Monch*), that are less often cultivated
45 worldwide.

46 Oats and buckwheat grains are unique due to their blend of macro, micro, and phytonutrients and their
47 consumption have been associated with various health benefits including reduced risk of cancer, obesity,
48 diabetes and cardiovascular diseases (CVD) (Borneo & Leon, 2012; Li, *et al.*, 2018; Rasane, *et al.*, 2015).
49 The observed health benefits have been attributed to their high content of dietary fibers such as β -
50 glucan, functional protein, essential fatty acids, vitamins, and antioxidant phytochemicals, including high
51 phenolic compounds (Flander L, 2007; Gangopadhyay, *et al.*, 2015). Due to its well-balanced nutritional
52 profile, oat is one of the most important cereal crops in the developed world. Compared with other
53 cereals, oats have higher concentrations of certain nutrients and phytochemicals and can tolerate harsher
54 growing conditions, such as wet climate and acidic soil, making them more resilient than other crops
55 (Grundy, *et al.*, 2018). Similarly, buckwheat, besides high starch content, is also rich in protein with a well-
56 balanced amino acid profile, dietary fiber, lipids, and minerals, along with other components such as
57 phenolic compounds and sterols (Ahmed, *et al.*, 2014; Krkoskova & Mrazova, 2005). Due to low gluten
58 content, both oat and buckwheat are suggested to be suitable substitutes for wheat, barley, and rye in
59 gluten-sensitive patients (Arendt & Zannini, 2013).

60 Recent studies suggested important differences in major phytochemical content between oat and
61 buckwheat (Dar, *et al.*, 2018; Keriene, *et al.*, 2015; Yu, *et al.*, 2018). Previous attempts to review the

62 literature on the phytochemical content of oat (Boz, 2015; Gangopadhyay, *et al.*, 2015; Sang & Chu, 2017)
63 and buckwheat(Ahmed, *et al.*, 2014; Zhan-Lu, *et al.*, 2012), were not systematic, did not report the
64 quantities of compounds identified, and did not directly compare phytonutrients between the two
65 cereals. Advancing the understanding of the two grains together can facilitate comparisons between oats
66 and buckwheat, help support the utilization of the two grains for consumer products, and justify their
67 combination in future studies. Thus, this systematic review of the literature aims to evaluate and compare
68 the profiles and quantities of phytochemicals commonly found in oat and buckwheat, and to explore the
69 potential of incorporating these two plants into human diets for optimal health and provide perspectives
70 for further investigation. We hope the present systematic review will help present the two plants as a
71 good option for growers to consider for their reported phytochemical contents and associated health
72 benefits, and the benefit of a more diverse set of crop cultivation from our current mono-crop centric
73 society.

74 2. METHODS

75 2.1 *Literature search*

76 This review was conducted following a recently published guideline on how to perform a systematic
77 review (Muka, *et al.*, 2020), following the PRISMA guidelines (Moher, *et al.*, 2009) (Supplemental Table 1)
78 and in accordance with the review protocol. Four bibliographic databases (PubMed, Embase, Web-of-
79 Science, and Cochrane Central Register of Controlled Trials) were used to identify published studies until
80 June 1, 2020 (date last searched) that examined the nutrient and bioactive composition of oat and
81 buckwheat. The search terms we used were related to nutrient and bioactive compounds (e.g., nutrients,
82 metabolism, phytochemical, carbohydrate, fatty acids) and the plants (oat and buckwheat) (Supplemental
83 Table 2). We did not apply any restrictions on language and date. However, we excluded conference

84 abstracts, letters to the editor and editorials. To retrieve additional publications, we checked the
85 reference lists of studies included in the current review.

86 *2.2 Study selection criteria*

87 Studies were included if they met the following inclusion criteria: (i) used samples of oat and/or
88 buckwheat; and (ii) evaluated nutrient and bioactive compounds. Two reviewers independently assessed
89 the titles and abstracts according to the selection criteria. For each potentially eligible study, two
90 reviewers assessed the full-text articles. In cases of disagreement, the decision was made by consensus,
91 or, if necessary, a third reviewer was consulted.

92 *2.3 Data extraction*

93 Two reviewers extracted data independently using a predesigned form, including first author and
94 publication year, plant's source, compound name, and concentration, as reported in the articles.

95

96 3. RESULTS

97 After searching the following electronic databases PubMed, Embase, Web of-Science, and Cochrane,
98 3,250 potentially relevant citations were identified, and after removing 817 duplicates, 2,433 abstracts
99 and titles were evaluated according to inclusion and exclusion criteria (Figure 1). Full texts and reference
100 lists of 201 studies were evaluated, among which 154 studies were eligible to be included in the current
101 review. In the 154 included studies (oat n=72 and buckwheat n=83), 113 phytochemicals and metabolites
102 were reported in oat and 178 in buckwheat, which we discuss in detail in the later sections. The list of all
103 phytochemicals reported in oat and buckwheat and the references can be found in Table 1&2, while
104 detailed information on phytochemical concentrations can be found in Supplemental Table 2 & 3. An
105 illustrative summary of the most important findings is presented in Figure 2.

106 3.1 Phenolic Compounds

107 Phenolic compounds consist of one or more aromatic rings, bearing one or more hydroxyl groups, and are
108 generally categorized as flavonoids, phenolic acids, stilbenes, polyphenolic amides (e.g.,
109 **avenanthramides**), coumarins, and tannins (Ahmed, *et al.*, 2014). Details on phenolic compounds
110 identified in oat and buckwheat are summarized in Table 1 &2 and Supplemental table 3.

111

112 3.1.1. Flavonoids

113 Flavonoids (flavonols, flavones, flavanols, flavonones, flavans, and anthocyanins) are phenolic
114 compounds, which comprise more than 4000 polyphenolic complexes (Tanwar & Modgil, 2012). In total,
115 16 and 64 flavonoids were reported in oat and buckwheat, respectively, and those are listed in Table 1 &
116 2 and Supplemental Table 2. Total flavonoid content ranged from 6 mg of rutin equivalents (RE)/100g in
117 groat to 3,149 mg RE /100g in unfermented buckwheat sprouts (Chen, *et al.*, 2018; XD Guo, *et al.*, 2011;
118 Peng, *et al.*, 2017; Sedej, *et al.*, 2012). Tartary buckwheat had a higher content of total flavonoids in
119 comparison with common buckwheat, with an indication that this difference decreases during
120 germination (Fabjan, *et al.*, 2003; Jiang, *et al.*, 2015; Tien, *et al.*, 2018). Rutin was a predominant flavonoid
121 compound detected in buckwheat. Although its content was high in all morphological parts of buckwheat,
122 its highest content was observed in buckwheat leaves (maximum 3,417 mg/100g) and bran (maximum
123 5,186mg/100g)(Habtemariam, 2019). Rutin levels were also up to 5-fold higher in tartary in comparison
124 to common buckwheat (Y Liu, *et al.*, 2019). Lower concentration of rutin was also reported in husked oat
125 fractions (0-3.2 mg/100g) and oat seeds (0.22-0.47 mg/100g) (Keriene, *et al.*, 2015; Tong, *et al.*, 2014).
126 Other flavonoids such as vitexin, isovitexin, orientin, and isoorientin were generally more abundant in
127 common buckwheat. Quercetin was the predominant flavonoid compound in oat with husked oat
128 samples having the highest concentration (up to 8.9 mg/100g) (Keriene, *et al.*, 2015). In common
129 buckwheat, quercetin concentrations ranged from 0.07 mg/100g in the hull to 33 mg/100g of buckwheat

130 sprouts with tartary buckwheat seeds reaching the levels as high as 291 mg/100g (XD Guo, *et al.*, 2011).
131 In general, a wide range of variations of flavonoids among buckwheat and oat cultivars was linked with
132 the variety, environmental factors, growing conditions, time of harvest, processing techniques and
133 anatomical part of the plant used(Fabjan, *et al.*, 2003; XD Guo, *et al.*, 2011; B. D. Oomah & G. Mazza,
134 1996; Tong, *et al.*, 2014).
135 Fagopyrin, flavonoid potentially harmful to human health, was mostly reported in buckwheat sprouts and
136 ranged from 0.0025% to 0.041% and from 0.10% to 0.12 % in common and tartary buckwheat sprouts
137 respectively; while in another study its concentration ranged from 19 to 32 mg/100g of common and
138 tartary buckwheat leaves and flowers respectively (Habtemariam, 2019; Kreft, *et al.*, 2013). Kreft at al,
139 however, suggest that the consumption of approximately 40 sprouts (0.14 g of dry mass sprouts per kg of
140 body mass per day) may not cause phototoxic effects. The intake of 10 g of dry mass (or approximately 30
141 g of fresh mass) of buckwheat sprouts may, on the other hand, cause health problems (such as dermatitis
142 and hair loss). Yet, the authors warn that the toxic dose may vary depending on exposure to sunlight,
143 body mass, and age (Kreft, *et al.*, 2013).

144 *3.1.2. Polyphenolics*

145 Total phenolic content in oat varied from 35.1 to 576 mg of mg/100g with oat bran concentrate having
146 the highest content. In buckwheat, total phenolic content was expressed in gallic acid (GAE) or rutin (RE)
147 equivalents reaching 670 GAE mg/100g in buckwheat seeds and sprouts, and 1,410 mg RE mg/100g in
148 common buckwheat husks. In general, oat bran, hulls, and groats had the highest total phenolic content.
149 Only two studies directly compared the total phenolic content in oat and buckwheat. Buckwheat husks
150 and grain with husks had 2 to 5-folds more phenolic compounds in comparison to oats samples, as
151 expressed in RE (Supplemental Table 2). In line with this, in another study comparing the GAE in both
152 plants, the buckwheat had higher total phenolic content (330.3-3.951.4 mg GAE/100g) in comparison to
153 oat (113.8 mg GAE/100g)(Holášová, *et al.*, 2002). Due to differences in units of measurements used, we

154 were not able to compare findings from other studies. A study directly comparing total phenolic content
155 in tartary and common buckwheat reported higher total phenolic content (667 mg GAE/100g) in tartary
156 buckwheat in comparison to common buckwheat seed samples (537 mg GAE/100g) (Y Liu, *et al.*, 2019). In
157 addition, the aerial extracts were richest in total phenols followed by the stem and the seed-buckwheat
158 extracts (A. R. Gulpinar, *et al.*, 2011; Holasova, *et al.*, 2002). Nine phenolic acids were quantified in both
159 oat and buckwheat samples: p-hydroxybenzoic and dihydroxybenzoic acid, caffeic, p-coumaric, ferulic,
160 vanillic, sinapic, gallic, and syringic acid (Table 1&2). The most abundant phenolic acid in oat was ferulic
161 acid, which levels reached 149.36 mg/100g in oat grain (Kovacova & Malinova, 2007). While p-anisic (also
162 known as 4-methoxybenzoic acid) acid was the most abundant phenolic acid in buckwheat and its levels
163 reached 1,190 mg/100g followed by vanillic acid which content reached 311.7mg/100g (Dziedzic, *et al.*,
164 2018; Sytar, 2015). All polyphenolic compounds identified in oat and buckwheat are listed in Tables 1 & 2.
165 Different solvents extraction methodology may explain differences in the extraction efficiency of phenolic
166 compounds found in the current review. For example, Dziedzic et al., found that the sum of phenolic
167 compounds obtained from different morphological parts of buckwheat (seed, flower, root) using
168 methanol was higher than compounds extracted using water (Dziedzic, *et al.*, 2018). Besides differences
169 caused by solvents used, across the studies, different cultivars, genetic varies, and growing conditions
170 were used, additionally affecting our findings. Indeed, all thermal treatments led to losses of total
171 phenolic acid concentration in the common buckwheat samples, the greatest losses were observed with
172 microwaving (-51.9%), followed by roasting (-33.3%), steaming (-23.5%) and boiling (-10.5%). Yet, an
173 increase in certain phenolic acids was also noted: roasting resulted in a 3.56-fold higher concentration of
174 syringic acid compared to the raw common buckwheat samples. Boiling and steaming caused a slight
175 increase in p-hydroxybenzoic acid and vanillic acid+caffeic acid and p-coumaric acid+syringaldehyde,
176 respectively (Y Liu, *et al.*, 2019).

177

178 3.1.3 Avenanthramides

179 Avenanthramides (AVAs) are a group of unique, low-molecular-weight hydroxycinnamoyl anthranilate
180 alkaloids uniquely present in oats. AVAs, besides affecting the flavour of oat products, have been
181 reported to improve health parameters in animal and human studies. They have antiproliferative,
182 antioxidant, anti-inflammatory, and anti-atherogenic properties (Leonova, *et al.*, 2008; Steadman, *et al.*,
183 2001; R. W. Welch, 1975).

184 In the current review, the amount of total AVAs in oats ranged from 0.5 mg/100g to 71.85 mg/100g
185 (Chen, *et al.*, 2018; Horbowicz & Obendorf, 1992; Hu, *et al.*, 2019; Peng, *et al.*, 2017; Tong, *et al.*, 2014).
186 AVAs present in more than 20 forms of which esters of 5-hydroxyanthranilic acid with p-coumaric (AVA-
187 A), caffeic (AVA-B) and ferulic acids (AVA-C) were the most abundant (Collins, *et al.*, 1991). Total AVAs
188 fluctuated significantly across the studies and varieties, with maximal variation of 29-fold (Chen, *et al.*,
189 2018). The highest AVAs content was observed in the bran and outer layer of oat kernels (its
190 concentration decreased from the outer layer to endosperm) (Chen, *et al.*, 2018; Hitayezu, *et al.*, 2015).
191 The most important factors influencing the AVAs content were the genotype and harvest time (A.R.
192 Gulpinar, *et al.*, 2011; Tong, *et al.*, 2014).

193 3.2 Tocols

194 Tocols (Vitamin E) are lipid-soluble compounds commonly found in vegetable oils, cereal grains (barley,
195 oats, wheat, rye, rice) and other sources. Tocols are comprised of tocopherols (TP) and tocotrienols (T3).
196 There are four homologs for TP and T3: α , β , γ and δ , which differ in the number and position of methyl
197 groups on the chroman ring structure (D. M. Peterson, *et al.*, 2007). The chemical structures of the tocols
198 determine their vitamin E activity. Different isomers of tocols exhibit vitamin E activity in the following
199 order α TP > β TP > α T3 > γ TP > β T3 > δ TP, with α T3 having the highest antioxidant potential (Panfili, *et al.*,
200 2008). In the present review, tocols content was in general higher in buckwheat than in oat (5.46-
201 55.22mg/100g in buckwheat vs 0.50-3.61 mg/100g in oat). The highest tocopherol content was reported

202 in whole grains and seeds. The most abundant tocots were alpha-tocotrienol and gamma-tocopherol in
203 oat and buckwheat, respectively. A detailed report on tocots identified in oat and buckwheat can be
204 found in Tables 1 & 2 and Supplemental Table 2.

205 *3.3 Phytosterols and fatty acids*

206 Phytosterols, plant-derived sterols, and stanols have been extensively studied due to their cholesterol-
207 lowering effect by inhibiting the absorption of intestinal cholesterol (Leonova, *et al.*, 2008). In cereal
208 grains, phytosterols can be found as free sterols, sterolesters, sterolglycosides and acylated
209 sterolglycosides. Long-chain fatty acids are the major constituents of oil in grain crops and are an
210 essential source of dietary energy.

211 The range of total phytosterol content was from 35mg/100g to 68.2 mg/100g in oats and 19mg/100g to
212 139 mg/100g in buckwheat (Table 1&2, Supplemental Table 3). The most abundant sterol in oat and
213 buckwheat was sitosterol accounting for more than 50-70 % of total sterols, followed by campesterol.

214 Cycloartanol was detected as a unique sterol in roasted and raw buckwheat products (Duve & White,
215 1991). When comparing the phytosterol composition of raw and roasted buckwheat grains, raw
216 buckwheat grains (BG-I) had much more stigmasterol (1.3 mg/g of lipids), while the contents of
217 campesterol, sitosterol, sitostanol, avenasterol, Δ-7-stigmasterol, and cycloartanol were significantly
218 lower (Hamberg, *et al.*, 1998). Raw buckwheat groats contained more campesterol (3.6 mg/g of lipids),
219 avenasterol (3.2 mg/g of lipids) and cycloartanol (1.9 mg/g of lipids) in comparison with roasted
220 buckwheat groat (R. W. Welch, 1975).

221 The fatty acid content in oat and buckwheat consisted mainly of high levels of unsaturated oleic (18:1)
222 and linoleic (18:2), and saturated palmitic (16:0) acids and lower levels of stearic (18:0) and linoleic (18:3)
223 acids (Supplemental Table 3). Changes in the relative abundance of fatty acids were linked to the different
224 anatomic part of the plant, genetic variants, and influence of various environmental growth factors was
225 reported (Doehlert, *et al.*, 2013; Sinkovic, *et al.*, 2020b; R. W. Welch, 1975),

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228 3.4 Polysaccharides

229 Polysaccharides represent a structurally diverse class of biological macromolecules, with a wide range of
230 physiological functions, including anticarcinogenic, hypolipidemic, immunoregulatory, antioxidant and
231 neuroprotective activities (A.R. Gulpinar, *et al.*, 2011). β -glucans are heterogeneous non-starch
232 polysaccharides, which occur in the walls of the endosperm cells (Dorrell, 1971b). β -glucans have been
233 associated with increased intestinal viscosity and linked with improved health outcomes, such as
234 improvements in serum blood lipids and enhanced efficiency of the immune system (Dorrell, 1971b). The
235 β -glucan content in oat ranged from 0.03% to 8.39% in germ and endosperm. In general, β -glucan
236 content was higher in oats (5,180- 28,200 mg/100g) than buckwheat (1,260-3,500 mg/100g) (Hozová, *et*
237 *al.*, 2008). Factors such as temperature, pH, and pH-temperature interaction of the extraction process
238 may influence β -glucan recovery and functionality (Tsuzuki, *et al.*, 1991). The amylose was the
239 predominant polysaccharide in buckwheat, reaching 25,000 mg/100g in buckwheat starch. In addition,
240 the levels of fagopyritols, mono-, di- and tri- galactosyl derivatives of D-chiro-inositol, were high
241 buckwheat. Total fagopyritols content in common buckwheat ranged from 128.2 to 2774.5 mg/100g,
242 suggesting that the common buckwheat starch may be the best source of fagopyritols.

243 3.5 Saponins

244 Saponins are found in various plant species, yet the oat represents the only saponin accumulating cereal.
245 Besides being responsible for the bitter flavour of oat and playing a role in plant defense against
246 environmental fungi attacks(Osbourn, *et al.*, 1994), saponins are suggested to promote human health by
247 lowering cholesterol levels and affecting the immune system(Shi, *et al.*, 2004). Avenacins, stored directly
248 in their active form, were reported in oat roots, while avenacosides (inactive forms) were reported in
249 leaves and grains (Mary, *et al.*, 1986; Rudolf Tschesche & Lauven, 1971; Rudolf Tschesche & Wiemann,

250 1977). Avenacosides A (1) and B (2) are converted to their active forms: 26-desglucoavenacoside A (3)
251 and 26-desglucoavenacoside B (4), Table 1, Supplemental Table 3. Avenacoside A represented 41.9%–
252 60.6% and 37.1%–57.7% of total saponin content in grain and in husks respectively. Avenacoside B
253 represented 35.8%–55.2% in grain and 13.8%–49.0% in husks of total saponin content. The content of 26-
254 desglucoavenacoside A reached 6.4% in grain 48.3% in husks (Pecio, *et al.*, 2013). Yet, the content of
255 avanacosides varied due to differences in cultivars, growth conditions, and sensitivity and precision of
256 quantification methods used across different studies (Onning & Asp, 1993).

257

258 4. Strengths and Limitations of Current Review

259 This review was conducted following the 24-Step guideline on how to perform a systematic review, and
260 following a predesigned review protocol (Muka, *et al.*, 2020). To exhaust relevant studies in the literature,
261 information specialists created a highly sensitive search strategy, and additional resources were searched
262 including the reference list of included studies. Thus, in this comprehensive systematic review of the
263 literature, we provided the first direct comparison of phytochemical content in oat and buckwheat.
264 However, our systematic review has some limitations worth mentioning. Although a highly sensitive
265 search strategy was used, we were not able to search all existing online databases, and we cannot
266 exclude the possibility of missed articles. Although we did not apply any restrictions on language and
267 publication date, we may have missed the articles published in languages other than English.
268 Furthermore, due to the high heterogeneity among the included studies (i.e. different anatomical part of
269 the plant used, extraction methods or reporting units), a quantification of different results was
270 challenging and in the results section we have focused on narrative summary of the most relevant
271 evidence.

272 5. Implications for Future Research

273 The current evidence on phytochemical compositions of oat and buckwheat is highly heterogeneous (due
274 to different genotypes, anatomical parts, cooking methods, extraction methods, etc.). A large number of
275 studies included in our systematic review were published before 2010s (n=91, 59.09%). Thus, those
276 extraction, purification and isolation methods of the active compounds in plants may not be as efficient
277 as analyses done in the most recent studies. Future studies should take advantage of the separation
278 technologies and the latest advances in plant genomics to investigate the genomic basis of the synthesis
279 and function of phytochemicals, particularly based on recent advances in omics research.

280 Over the past three decades, the health benefits of oat have been well documented. Despite its potential
281 to improve human health, buckwheat remains less often studied in clinical settings. Although the
282 bioactive components responsible for the beneficial health effects of buckwheat remain insufficiently
283 studied, its antioxidant potential and favorable lipid profile may be among the most important underlying
284 factors. However, only a limited number of studies have examined the bioavailability of select
285 phytochemicals (such as phenolic acids and polyphenols) from oats and buckwheat in humans and it
286 remains insufficiently studied how these phytocompounds are metabolized in human bodies and
287 influence human health. Thus, the findings from this review might help guide future research to further
288 explore the health promoting aspects of oat and buckwheat in relation to the major phytochemicals and
289 their metabolites, which in turn will shed light on health benefits these crops may deliver and their
290 potential to be incorporated into human diet for optimal health.

291

292 6. Conclusions

293 Oat and buckwheat are good sources of carbohydrates, proteins, fiber, nutrients, and bioactive
294 phytochemicals. Total phytosterols, tocots, flavonoids and rutin content were generally higher in

295 buckwheat, β -glucans were significantly higher in oat while avenanthramides and saponins were
296 characteristically found in oat. Despite slight differences in the content of bioactive compounds, health
297 benefits could be attributed to bioactive compounds originating from both plants, making them both an
298 essential constituent of human diets. For individuals with coeliac disease, these plants have the potential
299 to be a cornerstone of "gluten-free" diets due to its trace contents found in buckwheat and oats.
300 However, with the recent evidence on the role of food processing affecting the nutritional contents of
301 buckwheat and oat, the industry is put into a challenge in finding a proper balance of raw food
302 transformation. Further research is needed to identify the most active forms and the bioactivity of these
303 compounds present in oat and buckwheat and explore the health effects of the combination of nutrients
304 and phytochemicals.

305

- 306 Author's contribution
- 307 Study concept and design: Taulant Muka, Marija Glisic and Hua Kern.
- 308 Search strategy creation and online database search: Beatrice Minder.
- 309 Acquisition, collection, interpretation of data: Peter Francis Raguindin, Oche Adam Itodo, Jivko Stoyanov,
- 310 Gordana M. Dejanovic, Magda Gamba, Eralda Asllanaj.
- 311 Drafting of the manuscript: Peter Francis Raguindin, Oche Adam Itodo, Marija Glisic and Hua Kern.
- 312 Critical revision of the manuscript for important intellectual content: Jivko Stoyanov, Gordana M.
- 313 Dejanovic, Magda Gamba, Eralda Asllanaj, Beatrice Minder, Weston Bussler, Brandon Metzger, Taulant
- 314 Muka.
- 315 Study supervision: Marija Glisic and Hua Kern.
- 316 All authors approved the final version of the manuscript.
- 317
- 318 Author's disclosure
- 319 This research was supported by Standard Process. HK, WB, BMetzger are scientists at Standard Process
- 320 Nutrition Innovation Center. Other authors have nothing to disclose.

Table 1. Phytochemicals and metabolites identified in oat

| No. | Compound name | Source | Author, publication year |
|------------------------|---|--|--|
| Phytosterols | | | |
| 1 | Δ^5 -avenasterol | oat flour and bran; oat seed | (Maatta, <i>et al.</i> , 1999; Shewry, <i>et al.</i> , 2008) |
| 2 | Δ^7 -avenasterol | oat flour and bran; oat seed | (Maatta, <i>et al.</i> , 1999; Shewry, <i>et al.</i> , 2008) |
| 4 | 24-methylene cycloartanol | roots of oat seedlings | (Trojanowska, <i>et al.</i> , 2000) |
| 3 | 7-hydroxymatairesinol | oat seed | (Smeds, <i>et al.</i> , 2009) |
| 5 | campesterol | oat flour and bran | (Maatta, <i>et al.</i> , 1999; Shewry, <i>et al.</i> , 2008) |
| 6 | cycloartenol | roots of oat seedlings | (Trojanowska, <i>et al.</i> , 2000) |
| 7 | flavonolignans | oat (Poaceae) herb/plant | (Wenzig, <i>et al.</i> , 2005) |
| 8 | lariciresinol | oat seed | (Smeds, <i>et al.</i> , 2009) |
| 9 | medioresinol | oat seed | (Smeds, <i>et al.</i> , 2009) |
| 10 | metairesinol | oat seed | (Smeds, <i>et al.</i> , 2009) |
| 11 | pinoresinol | oat seed | (Smeds, <i>et al.</i> , 2009) |
| 12 | secoisolariciresinol | oat seed | (Smeds, <i>et al.</i> , 2009) |
| 13 | sitosterol | oat flour and bran; oat seed | (Maatta, <i>et al.</i> , 1999; Shewry, <i>et al.</i> , 2008) (Eichenberger Wa U, 1984) |
| 14 | stanols | oat flour and bran | (Shewry, <i>et al.</i> , 2008) |
| 15 | sterylglycosides | oat leaves | (Eichenberger Wa U, 1984) |
| 16 | stigmasterol | oat flour and bran | (Maatta, <i>et al.</i> , 1999; Shewry, <i>et al.</i> , 2008) (Eichenberger Wa U, 1984) |
| 17 | syringaresinol | oat seed | (Smeds, <i>et al.</i> , 2009) |
| Flavonoids | | | |
| 18 | 4'-O-(<i>erythro</i> - β -guaiacylglyceryl) | oat (Poaceae) herb/plant | (Wenzig, <i>et al.</i> , 2005) |
| 19 | 4'-O-(<i>threo</i> - β -guaiacylglyceryl) | oat (Poaceae) herb/plant | (Wenzig, <i>et al.</i> , 2005) |
| 20 | apigenin | oats | (Rice-Evans & Paganga, 1997) |
| 21 | kaempferol 3-O-(2",3"-di-E-p-coumaroyl- α -L-rhamnopyranoside) | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 22 | kaempferol 3-O-(2" -O-E-p-coumaroyl- α -L-rhamnopyranoside) | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 23 | kaempferol 3-O-(2" -O-E-p-coumaroyl- β -D-rhamnopyranoside) | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 24 | kaempferol 3-O-(3" -E-p-coumaroyl- α -L-rhamnopyranoside) | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 25 | kaempferol 3-O- β -D-glucopyranoside | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 26 | linarin | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 27 | luteolin | oats | (Collins, 1986) |
| 28 | myricitrin | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 29 | quercetin | husked and common oat | (Keriene, <i>et al.</i> , 2015) |
| 30 | quercitrin | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 31 | rutin | husked oat | (Keriene, <i>et al.</i> , 2015) |
| 32 | tilianin | oat bran | (WK Zhang, <i>et al.</i> , 2012) |
| 33 | tricin | oats | (Collins, 1986) |
| Polysaccharides | | | |
| 34 | β -Glucan | starch; commercial oat bran; rolled oats | (Dawkins & Nnanna, 1995; Doehlert, <i>et al.</i> , 2013; Manthey, <i>et al.</i> , 1999; Regand, <i>et al.</i> , 2011; Shewry, <i>et al.</i> , 2008; Sowa & White, 1992 ; van den Broeck, <i>et al.</i> , 2015) |

| Phenolics | | | |
|-----------|---|---|--|
| 33 | 2,2-diphenyl-1-picrylhydrazyl | hull and groat | (Varga, <i>et al.</i> , 2018) |
| 34 | 4-hydrobenzoic acid | oat flour and bran | (Duve & White, 1991; Gallagher, <i>et al.</i> , 2010; Shewry, <i>et al.</i> , 2008; Sosulski, <i>et al.</i> , 2019 ; Varga, <i>et al.</i> , 2018) |
| 35 | avenalumic acid and its 3'-hydroxy and 3'-methoxy derivatives | oat groats and hulls | (Collins, <i>et al.</i> , 1991) |
| 36 | Caffeic acid | oat flour; hull and groat | (Calinoiu & Vodnar, 2019 ; Dimberg, <i>et al.</i> , 1993; Emmons & Peterson, 1999; Hitayezu, <i>et al.</i> , 2015; Skoglund, <i>et al.</i> , 2008; Sosulski, <i>et al.</i> , 1982; Sosulski, <i>et al.</i> , 2019; Varga, <i>et al.</i> , 2018; Xing & White, 1997) |
| 37 | coumaric acid | husked oat | (Multari, <i>et al.</i> , 2018) |
| 38 | ferulic acid | oat flour; husked oat; rolled oat; hull and groat | (Calinoiu & Vodnar, 2019; Dokuyucu, <i>et al.</i> , 2003; Emmons & Peterson, 1999; Gallagher, <i>et al.</i> , 2010; Hitayezu, <i>et al.</i> , 2015; Kovacova & Malinova, 2007; Multari, <i>et al.</i> , 2018; Skoglund, <i>et al.</i> , 2008; Sosulski, <i>et al.</i> , 1982; Sosulski, <i>et al.</i> , 2019; Varga, <i>et al.</i> , 2018; V. Verardo, <i>et al.</i> , 2011; Xing & White, 1997) |
| 39 | gallic acid | hull and groat | (Brindzova, <i>et al.</i> , 2008; Chen, <i>et al.</i> , 2018; Emmons & Peterson, 1999) |
| 40 | o-coumaric acid | husked oat | (Gallagher, <i>et al.</i> , 2010; Multari, <i>et al.</i> , 2018; Xing & White, 1997) |
| 41 | p-cinnamic | oat milling fractions; husked oat | (Bratt, <i>et al.</i> , 2003; Dimberg, <i>et al.</i> , 2005; Hitayezu, <i>et al.</i> , 2015; Multari, <i>et al.</i> , 2018) |
| 42 | p-coumaric acid | oat flour and bran; rolllead oat; hull and groat | (Calinoiu & Vodnar, 2019; Dokuyucu, <i>et al.</i> , 2003; Emmons & Peterson, 1999; Shewry, <i>et al.</i> , 2008; Skoglund, <i>et al.</i> , 2008; Sosulski, <i>et al.</i> , 2019; Varga, <i>et al.</i> , 2018; Xing & White, 1997) |
| 43 | <i>p</i> -hydroxybenzaldehyde | hull and groat | (Emmons & Peterson, 1999 ; Sosulski, <i>et al.</i> , 2019 ; Varga, <i>et al.</i> , 2018 ; V. Verardo, <i>et al.</i> , 2011) |
| 44 | <i>p</i> -hydroxybenzoic acid | oat flour | (Calinoiu & Vodnar, 2019; Sosulski, <i>et al.</i> , 1982 ; Xing & White, 1997) |
| 45 | phytic acid | oat products | (Larsson & Sandberg, 1992) |
| 46 | sinapic acid | oat flour | (Calinoiu & Vodnar, 2019 ; Shewry, <i>et al.</i> , 2008 ; Sosulski, <i>et al.</i> , 2019; Xing & White, 1997) |
| 47 | syringaldehyde | husked oat | (Gallagher, <i>et al.</i> , 2010; Multari, <i>et al.</i> , 2018) |
| 48 | syringic | oat flour; husked oat | (Shewry, <i>et al.</i> , 2008; Sosulski, <i>et al.</i> , 1982; Sosulski, <i>et al.</i> , 2019; Varga, <i>et al.</i> , 2018 ; V. Verardo, <i>et al.</i> , 2011) |
| 49 | <i>trans</i> -cinnamic acid | hull and groat | (Emmons & Peterson, 1999) |
| 50 | <i>trans</i> -ferulic | oat flour | (Sosulski, <i>et al.</i> , 1982); |
| 51 | vanillic acid | oat flour; husked oat | (Calinoiu & Vodnar, 2019; Emmons & Peterson, 1999 ; Gallagher, <i>et al.</i> , 2010 ; Garleb, <i>et al.</i> , 1991; Hitayezu, <i>et al.</i> , 2015; Multari, <i>et al.</i> , 2018 ; Shewry, <i>et al.</i> , 2008; Sosulski, <i>et al.</i> , 1982; Sosulski, <i>et al.</i> , 2019; Varga, <i>et al.</i> , 2018; V. Verardo, <i>et al.</i> , 2011; Xing & White, 1997) |
| Alkaloids | | | |
| 52 | AVA-2fd | seeds | (de Bruijn, <i>et al.</i> , 2019) |

| | | | |
|----|---------|--------------------------------------|---|
| 53 | AVA-2pd | seeds | (de Bruijn, <i>et al.</i> , 2019) |
| 54 | AVA-5fd | seeds | (de Bruijn, <i>et al.</i> , 2019) |
| 55 | AVA-5pd | seeds | (de Bruijn, <i>et al.</i> , 2019) |
| 56 | AVA-2C | oat milling fractions; husked oat | (Bratt, <i>et al.</i> , 2003; Calinoiu & Vodnar, 2019; Chen, <i>et al.</i> , 2018; de Bruijn, <i>et al.</i> , 2019; Dimberg, <i>et al.</i> , 2005 ; Dokuyucu, <i>et al.</i> , 2003; Gunther-Jordanland, <i>et al.</i> , 2016; Hitayezu, <i>et al.</i> , 2015; Hu, <i>et al.</i> , 2019; Mattila, <i>et al.</i> , 2005; Multari, <i>et al.</i> , 2018; Ortiz-Robledo, <i>et al.</i> , 2013; D. M. Peterson & Dimberg, 2008; Pridal, <i>et al.</i> , 2018; Shewry, <i>et al.</i> , 2008; Skoglund, <i>et al.</i> , 2008; Varga, <i>et al.</i> , 2018; V. Verardo, <i>et al.</i> , 2011; Xie, <i>et al.</i> , 2017) |
| 57 | AVA-2F | oat milling fractions; husked oat | (Bratt, <i>et al.</i> , 2003; Calinoiu & Vodnar, 2019; Chen, <i>et al.</i> , 2018; Dimberg, <i>et al.</i> , 2005 ; Dokuyucu, <i>et al.</i> , 2003; Gunther-Jordanland, <i>et al.</i> , 2016; Hitayezu, <i>et al.</i> , 2015; Hu, <i>et al.</i> , 2019; Mattila, <i>et al.</i> , 2005; Multari, <i>et al.</i> , 2018; Ortiz-Robledo, <i>et al.</i> , 2013; D. M. Peterson & Dimberg, 2008; Pridal, <i>et al.</i> , 2018 ; Shewry, <i>et al.</i> , 2008; Skoglund, <i>et al.</i> , 2008; Varga, <i>et al.</i> , 2018; Xie, <i>et al.</i> , 2017); |
| 58 | AVA-2P | oat milling fractions; husked oat | (Bratt, <i>et al.</i> , 2003; Calinoiu & Vodnar, 2019; Chen, <i>et al.</i> , 2018; Dimberg, <i>et al.</i> , 2005 ; Dokuyucu, <i>et al.</i> , 2003; Gunther-Jordanland, <i>et al.</i> , 2016; Hitayezu, <i>et al.</i> , 2015; Hu, <i>et al.</i> , 2019 ; Mattila, <i>et al.</i> , 2005; Multari, <i>et al.</i> , 2018; Ortiz-Robledo, <i>et al.</i> , 2013; D. M. Peterson & Dimberg, 2008; Pridal, <i>et al.</i> , 2018 ; Shewry, <i>et al.</i> , 2008; Skoglund, <i>et al.</i> , 2008; Varga, <i>et al.</i> , 2018; Xie, <i>et al.</i> , 2017) |
| 59 | AVA A-1 | oat flour and bran groat and hull | (Bratt, <i>et al.</i> , 2003; Chen, <i>et al.</i> , 2018 ; Collins, 1989 ; Gunther-Jordanland, <i>et al.</i> , 2016 ; Hu, <i>et al.</i> , 2019) (Collins, 1989; Dimburg, <i>et al.</i> , 1993) |
| 60 | AVA B | groat and hull | (Collins, 1989) |
| 61 | AVA B-1 | groat and hull | (Collins, 1989) |
| 62 | AVA C | groat and hull | (Collins, 1989 ; Soycan, <i>et al.</i> , 2019) |
| 63 | AVA C-1 | groat and hull | (Collins, 1989) |
| 64 | AVA D | groat and hull | (Collins, 1989) |
| 65 | AVA D-1 | groat and hull | (Collins, 1989) |
| 66 | AVA E | groat and hull | (Collins, 1989) |
| 67 | AVA E-1 | groat and hull | (Collins, 1989) |

| | | | |
|--------------------|--|---|--|
| 68 | AVA-1F | oat flour | (Bratt, <i>et al.</i> , 2003; Chen, <i>et al.</i> , 2018; Collins, 1989; Gunther-Jordanland, <i>et al.</i> , 2016) |
| 69 | AVA-1P | oat flour | (Bratt, <i>et al.</i> , 2003; Chen, <i>et al.</i> , 2018 ; Collins, 1989; Gunther-Jordanland, <i>et al.</i> , 2016) |
| 70 | AVA-1S | oat flour | (Bratt, <i>et al.</i> , 2003; Chen, <i>et al.</i> , 2018 ; Collins, 1989; Gunther-Jordanland, <i>et al.</i> , 2016) |
| 71 | AVA-2S | oat flour | (Gunther-Jordanland, <i>et al.</i> , 2016) |
| 72 | AVA-3F | grains | (Skoglund, <i>et al.</i> , 2008) |
| 73 | AVA-6f | seeds | (de Bruijn, <i>et al.</i> , 2019) |
| n.a. | avenanthramides total | oat groats, hulls and seeds; husked oat | (Bratt, <i>et al.</i> , 2003; Chen, <i>et al.</i> , 2018; Collins, <i>et al.</i> , 1991; Emmons & Peterson, 1999; Hu, <i>et al.</i> , 2019; Ishihara, <i>et al.</i> , 2014; Multari, <i>et al.</i> , 2018 ; Pridal, <i>et al.</i> , 2018; Shewry, <i>et al.</i> , 2008; Xie, <i>et al.</i> , 2017) |
| 74 | gramine | Avena sativa | (Duke, 1992) |
| Tocols | | | |
| 75 | α -T | various oats | (Musa Ozcan, <i>et al.</i> , 2006; D.M. Peterson & Qureshi, 1993; Shewry, <i>et al.</i> , 2008; van den Broeck, <i>et al.</i> , 2015; York, <i>et al.</i> , 1993) |
| 76 | A-T3 | various oats | (Shewry, <i>et al.</i> , 2008; van den Broeck, <i>et al.</i> , 2015; York, <i>et al.</i> , 1993) |
| 77 | B-T | various oats | (Musa Ozcan, <i>et al.</i> , 2006; Shewry, <i>et al.</i> , 2008; York, <i>et al.</i> , 1993) |
| 78 | B-T3 | various oats | (Shewry, <i>et al.</i> , 2008; York, <i>et al.</i> , 1993) |
| 79 | g-T | various oats | (Musa Ozcan, <i>et al.</i> , 2006; York, <i>et al.</i> , 1993) |
| 80 | 6-T3 | various oats | (York, <i>et al.</i> , 1993) |
| Folates | | | |
| 81 | Total folates | oat flour and bran | (Shewry, <i>et al.</i> , 2008) |
| Proteins/enzymes | | | |
| 82 | fraction I protein | Oat leaves | (Steer, <i>et al.</i> , 1968) |
| 83 | globulin | various oats | (Klose, <i>et al.</i> , 2009; Runyon, <i>et al.</i> , 2013) |
| 84 | glutelin | oat seeds/groat | (Klose, <i>et al.</i> , 2009; Runyon, <i>et al.</i> , 2013) |
| 85 | oat protein isolate | Chinese oat | (G Liu, <i>et al.</i> , 2009) |
| 86 | prolamin | oat seeds/groat | (Klose, <i>et al.</i> , 2009) |
| Lipids/Fatty Acids | | | |
| 87 | 1,2-diacylglycerol | wild and cultivated oat | (Leonova, <i>et al.</i> , 2008) |
| 88 | 1,3-diacylglycerol | wild and cultivated oat | (Leonova, <i>et al.</i> , 2008) |
| 89 | 7-hydroxyhexadecanoic | wild and cultivated oat | (Leonova, <i>et al.</i> , 2008) |
| 90 | cylphosphatidylglycerols | oat extract | (Holmback, <i>et al.</i> , 2001) |
| 91 | 1-[(9'Z),(12'Z)-octadecadienoyl]-2-[(15''R)-(C Chen, <i>et al.</i> , 2020)- (9''Z),(12''Z)-octadecadienoyl]-3-(α -D-galactopyranosyl-1-6- β -D-galactopyranosyl)-glycerol. | oat seeds | (Hamberg, <i>et al.</i> , 1998) |
| 92 | galactolipid estolides | oat kernels | (Moreau, <i>et al.</i> , 2008) |
| 93 | N-acylphosphatidylethanolamines | oat extract | (Holmback, <i>et al.</i> , 2001) |
| 94 | sterylglycosides | oat leaves | (Eichenberger Wa U, 1984) |

| | | | |
|----------|--|-------------------------|--|
| 95 | TAG1 | wild and cultivated oat | (Leonova, <i>et al.</i> , 2008) |
| 96 | TAG2 | wild and cultivated oat | (Leonova, <i>et al.</i> , 2008) |
| 97 | C:16 | Oat various cultivars | (Banas, <i>et al.</i> , 2007; Brindzova, <i>et al.</i> , 2008; Dimberg, <i>et al.</i> , 2005; Duve & White, 1991; van den Broeck, <i>et al.</i> , 2015; R.W. Welch, 1975) |
| 98 | C18:0 | oat various cultivars | (Banas, <i>et al.</i> , 2007; Brindzova, <i>et al.</i> , 2008; Dimberg, <i>et al.</i> , 2005 ; Duve & White, 1991; van den Broeck, <i>et al.</i> , 2015; R.W. Welch, 1975) |
| 99 | C18:1 | oat various cultivars | (Banas, <i>et al.</i> , 2007; Brindzova, <i>et al.</i> , 2008; Dimberg, <i>et al.</i> , 2005; Duve & White, 1991; van den Broeck, <i>et al.</i> , 2015; R.W. Welch, 1975) |
| 100 | C18:2 | oat various cultivars | (Banas, <i>et al.</i> , 2007; Brindzova, <i>et al.</i> , 2008; Dimberg, <i>et al.</i> , 2005; Duve & White, 1991; van den Broeck, <i>et al.</i> , 2015; R.W. Welch, 1975) |
| 101 | Avenoleic acid | oat seeds; | (Hamberg, <i>et al.</i> , 1998) |
| 102 | 15-hydroxy 18:2 ^{Δ9,12} (avenoleic acid) | wild and cultivated oat | (Leonova, <i>et al.</i> , 2008) |
| Saponins | | | |
| 103 | 3-(O- α -L-rhamnopyranosyl(1 \rightarrow 2)-[β -D-glucopyranosyl(1 \rightarrow 4)]- β -D-glucopyranosid)-26-O- β -D-glucopyranosyl-(25R)-furost-5-ene-3 β ,22,26-triol | oat flour | (Gunther-Jordanland, <i>et al.</i> , 2016) |
| 104 | 3-(O- α -L-rhamnopyranosyl(1 \rightarrow 2)-[β -D-glucopyranosyl(1 \rightarrow 3)- β -D-glucopyranosyl(1 \rightarrow 4)]- β -D-glucopyranosid)-26-O- β -D-glucopyranosyl-(25R)-furost-5-ene-3 β ,22,26-triol | oat flour | (Gunther-Jordanland, <i>et al.</i> , 2016) |
| 105 | avenacoside A (nuatigenin-3-O-(α -L-rhamnopyranosyl-(1 \rightarrow 2)-[β -D-glucopyranosyl(1 \rightarrow 4)]- β -D-glucopyranoside)-26-O- β -D-glucopyranoside) | oat flour, grain | (Bahraminejad, <i>et al.</i> , 2008; Gunther-Jordanland, <i>et al.</i> , 2016; Onning & Asp, 1993; Pecio, <i>et al.</i> , 2013; Rudolf Tschesche, <i>et al.</i> , 1969; Rudolf Tschesche & Wiemann, 1977) |
| 106 | avenacoside B (nuatigenin-3-O-(α -L-rhamnopyranosyl-(1 \rightarrow 2)-[β -D-glucopyranosyl(1 \rightarrow 3)- β -D-glucopyranosyl(1 \rightarrow 4)]- β -D-glucopyranoside)-26-O- β -D-glucopyranoside) | oat flour, grains | (Bahraminejad, <i>et al.</i> , 2008; Gunther-Jordanland, <i>et al.</i> , 2016; Onning & Asp, 1993; Pecio, <i>et al.</i> , 2013; Rudolf Tschesche & Lauven, 1971; Rudolf Tschesche & Wiemann, 1977; R. Tschesche & Wulff, 1973) |
| 107 | Avenacin A-1* | | (Mary, <i>et al.</i> , 1986) |
| 108 | Avenacin A-2 | | (Mary, <i>et al.</i> , 1986) |
| 109 | Avenacin B-1 | | (Mary, <i>et al.</i> , 1986) |
| 110 | Avenacin B-2 | | (Mary, <i>et al.</i> , 1986) |
| 111 | 26-desglucoavenacoside A | grain | (Bahraminejad, <i>et al.</i> , 2008; Pecio, <i>et al.</i> , 2013) |
| 112 | 26-desglucoavenacoside B | Shoots | (Bahraminejad, <i>et al.</i> , 2008) |
| 113 | avenacins (b-Amyrin, squalene) | roots of oat seedlings | (Trojanowska, <i>et al.</i> , 2000) |

* A-1, A-2, B-1 and B-2: these are trisaccharide-bearing triterpenes esterified (A-1, B-1) with N-methylantranilic acid or (A-2, B-2) benzoic acid.

Table 2 Phytochemicals reported in buckwheat

| No. | Compound name | Source | Author, publication year |
|----------------------|------------------------------------|--------|--|
| Tannins | | | |
| 1 | procyanidin B-1 | Fd | (KJ Wang, <i>et al.</i> , 2005) |
| 2 | procyanidin B-2 | Fd | (KJ Wang, <i>et al.</i> , 2005) |
| 3 | 3,3-di-O-galloyl-procyanidinB-2 | Fd | (KJ Wang, <i>et al.</i> , 2005) |
| 4 | 3-O-galloyl-procyanidinB-2 | Fd | (KJ Wang, <i>et al.</i> , 2005) |
| Cyclitol | | | |
| 5 | fagopyritol A1 | Fe | (Ralph L. Obendorf, <i>et al.</i> , 2000) |
| 6 | fagopyritol A2 | Fe | (Steadman, <i>et al.</i> , 2001) |
| 7 | fagopyritol A3 | Fe | (Steadman, <i>et al.</i> , 2001) |
| 8 | fagopyritol B1 | Fe | (Ralph L. Obendorf, <i>et al.</i> , 2000) |
| 9 | fagopyritol B2 | Fe | (R. L. Obendorf, 1997) |
| 10 | fagopyritol B3 | Fe | (R. L. Obendorf, 1997) |
| Triterpenoids | | | |
| 11 | ursolic acid | Ft | (JM Lee, <i>et al.</i> , 2013) |
| 12 | olean-12-en-3-ol | Fe | (F Zheng, <i>et al.</i> , 2004) |
| 13 | urs-12-en-3-ol | Fe | (F Zheng, <i>et al.</i> , 2004) |
| 14 | glutinone | Fd | (Shao, <i>et al.</i> , 2005) |
| 15 | glutinol | Fd | (Shao, <i>et al.</i> , 2005) |
| Steroids | | | |
| 16 | β -sitosterol | Fd | (Bao, <i>et al.</i> , 2003) |
| 17 | daucosterol | Fd | (Bao, <i>et al.</i> , 2003) |
| 18 | peroxidize-ergosterol | Fd | (Bao, <i>et al.</i> , 2003) |
| 19 | stigmsat-4-en -3,6-dione | Fd | (Bao, <i>et al.</i> , 2003) |
| 20 | β -sitosterol-palmitate | Fd | (Bao, <i>et al.</i> , 2003) |
| 21 | 6-hydroxystigmasta-4,22-dien-3-one | Fe | (F Zheng, <i>et al.</i> , 2004) |
| 22 | 23S-methylcholesterol | Fe | (F Zheng, <i>et al.</i> , 2004) |
| 23 | trans-stigmast-5,22-dien-3-ol | Fe | (F Zheng, <i>et al.</i> , 2004) |
| 24 | stigmast-5,24-dien-3-ol | Fe | (F Zheng, <i>et al.</i> , 2004) |
| 25 | stigmast-5-en-3-ol | Fe | (F Zheng, <i>et al.</i> , 2004) |
| Fatty acids | | | |
| 26 | C24:0 | Fe | (Krumina-Zemture & Beitane, 2018; Tien, <i>et al.</i> , 2018; Tsuzuki, <i>et al.</i> , 1991) |
| 27 | C24:1 | Fe | (Krumina-Zemture & Beitane, 2018) |
| 28 | C12:0 | Ft | (Tien, <i>et al.</i> , 2018) |
| 29 | C14:0 | Ft, Fe | (Golijan, <i>et al.</i> , 2019; Krumina-Zemture & Beitane, 2018; Tien, <i>et al.</i> , 2018) |
| 30 | C15:0 | Ft | (Krumina-Zemture & Beitane, 2018; Tien, <i>et al.</i> , 2018) |
| 31 | C16:0 | Fe, Ft | (Dziadek, <i>et al.</i> , 2016; Golijan, <i>et al.</i> , 2019; A.R. Gulpinar, <i>et al.</i> , 2011; Khalass, <i>et al.</i> , 2018; Krumina-Zemture & Beitane, 2018; Sinkovic, <i>et al.</i> , 2020a; Tien, <i>et al.</i> , 2018 ; Tsuzuki, <i>et al.</i> , 1991) |
| 32 | C16:1 | Ft | (Golijan, <i>et al.</i> , 2019; Tien, <i>et al.</i> , 2018) |
| 33 | C17:1 | Ft | (Tien, <i>et al.</i> , 2018) |
| 34 | C18:0 | Fe, Ft | (Dziadek, <i>et al.</i> , 2016; Golijan, <i>et al.</i> , 2019 ; A.R. Gulpinar, <i>et al.</i> , 2011; Khalass, <i>et al.</i> , 2018; Krumina-Zemture & Beitane, 2018 ; Sinkovic, <i>et al.</i> , 2020a; Tien, <i>et al.</i> , 2018; Tsuzuki, <i>et al.</i> , 1991) |
| 35 | C18:1 | Fe, Ft | (Dorrell, 1971a; Dziadek, <i>et al.</i> , 2016; Golijan, <i>et al.</i> , 2019; A.R. Gulpinar, <i>et al.</i> , 2011 ; Khalass, <i>et al.</i> , 2018; Krumina-Zemture & Beitane, 2018; Sinkovic, <i>et al.</i> , 2020a; Tien, <i>et al.</i> , 2018; Tsuzuki, <i>et al.</i> , 1991) |
| 36 | C18:2 | Fe, Ft | (Dziadek, <i>et al.</i> , 2016; Golijan, <i>et al.</i> , 2019; A.R. Gulpinar, <i>et al.</i> , 2011; Khalass, <i>et al.</i> , 2018; Sinkovic, <i>et al.</i> , 2020a; Tien, <i>et al.</i> , 2018; Tsuzuki, <i>et al.</i> , 1991) |
| 37 | C18:3 | Fe, Ft | (Golijan, <i>et al.</i> , 2019; A.R. Gulpinar, <i>et al.</i> , 2011; Krumina-Zemture & Beitane, 2018 ; Sinkovic, <i>et al.</i> , 2020a; Tien, <i>et al.</i> , 2018; Tsuzuki, <i>et al.</i> , 1991); |

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| 38 | C20:0 | Fe, Ft | (Golijan, <i>et al.</i> , 2019; A.R. Gulpinar, <i>et al.</i> , 2011; Sinkovic, <i>et al.</i> , 2020a ; Tsuzuki, <i>et al.</i> , 1991); |
| 39 | C20:1 | Fe, Ft | (Golijan, <i>et al.</i> , 2019; A.R. Gulpinar, <i>et al.</i> , 2011; Krumina-Zemture & Beitane, 2018; Tien, <i>et al.</i> , 2018; Tsuzuki, <i>et al.</i> , 1991) |
| 40 | C20:5 | Fe | (Krumina-Zemture & Beitane, 2018) |
| 41 | C22:0 | Fe, Ft | (Tien, <i>et al.</i> , 2018) |
| 42 | C22:1 | Fe | (A.R. Gulpinar, <i>et al.</i> , 2011; Tien, <i>et al.</i> , 2018; Tsuzuki, <i>et al.</i> , 1991) |
| 43 | C23:0 | Fe | (Krumina-Zemture & Beitane, 2018) |
| 44 | 4,7-dihydroxy-3,7-dimethyl-octa-2(E),5(E)-dienoic acid | Fe | (Cho, <i>et al.</i> , 2006) |
| 45 | 6,7-dihydroxy-3,7-dimethyl-octa-2(Z),4(E)-dienoic acid | Fe | (Cho, <i>et al.</i> , 2006) |
| 46 | 6,7-dihydroxy-3,7-dimethyl-octa-2(E),4(E)-dienoic acid | Fe | (Cho, <i>et al.</i> , 2006) |
| Polysaccharides | | | |
| 40 | amylopectin | Fe | (Qin, <i>et al.</i> , 2010; Takahama & Hirota, 2010) |
| 47 | amylose | Fe | (Qin, <i>et al.</i> , 2010; Takahama & Hirota, 2010) |
| 41 | BBF1-3 | Fl | (Lin & Lin, 2016) |
| 48 | BWPSs | Fe | (Zemnukhova, <i>et al.</i> , 2007; Zemnukhova, <i>et al.</i> , 2004) |
| 49 | CBF1-3 | Fe | (Lin & Lin, 2016) |
| 39 | galactinol | Fe | (Steadman, <i>et al.</i> , 2000) |
| 50 | inositol | Fe | (Steadman, <i>et al.</i> , 2001) |
| 51 | myo-inositol | Fe | (Steadman, <i>et al.</i> , 2000) |
| 52 | SDF (carboxymethylated) | Fe | (KY Lee, <i>et al.</i> , 2014) |
| 53 | SDF (methanolysis) | Fe | (Wefers & Bunzel, 2015) |
| 54 | sucrose | Fe | (Steadman, <i>et al.</i> , 2000) |
| 55 | TBP-1-3 | Fe | (Yan, <i>et al.</i> , 2011) |
| 56 | TBP-II | Ft | (XT Wang, <i>et al.</i> , 2016) |
| 57 | α -galactosides | Fe | (Steadman, <i>et al.</i> , 2000) |
| | Beta-glucan | Fe | (Hozová, <i>et al.</i> , 2008) |
| Phenols | | | |
| 58 | 1,3,6-tri-feruloyl-6-p-coumaroyl sucrose | Ft | (Ren, <i>et al.</i> , 2013) |
| 59 | 1,3,6-tri-p-coumaroyl-61-feruloyl sucrose | Ft | (Ren, <i>et al.</i> , 2013) |
| 60 | 1,3-dimethoxy-2-O-b-xylo-pyranosyl-5-O-glucopyranosyl-benzene | Fd | (Bai, <i>et al.</i> , 2007) |
| 61 | 3,4-dihydroxybenzaldehyde | Fd, Fe | (Shao, <i>et al.</i> , 2005); (Watanabe, <i>et al.</i> , 1997) |
| 62 | 3,6-di-p-coumaroyl-1,61-di-feruloyl sucrose | Ft | (Ren, <i>et al.</i> , 2013) |
| 63 | benzoic acid | Fd | (Park, <i>et al.</i> , 2019; Wu, <i>et al.</i> , 2008) |
| 64 | caffeic acid | Ft, Fe | (Alvarez-Jubete, <i>et al.</i> , 2010; Park, <i>et al.</i> , 2019; Terpinc, <i>et al.</i> , 2016; Wefers & Bunzel, 2015; Xu, <i>et al.</i> , 2002) |
| 65 | chlorogenic acid | Fe, Ft | (SJ Kim, <i>et al.</i> , 2008; Kraujaliene, <i>et al.</i> , 2017; Y Liu, <i>et al.</i> , 2019; Pankaja, 2011; Park, <i>et al.</i> , 2019) |

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| | | | <i>al.</i> , 2019; Sadauskiene, <i>et al.</i> , 2018; Sytar, 2015) |
| 66 | Neochloreogenic | Fe | (Sadauskiene, <i>et al.</i> , 2018) |
| 67 | Fagopyrin | Fe | (Habtemariam, 2019; Sadauskiene, <i>et al.</i> , 2018) |
| 68 | Tannic acid | Fe | (Sadauskiene, <i>et al.</i> , 2018) |
| 69 | Hyperoside | Fe | (Quettier-Deleu, <i>et al.</i> , 2000; Sadauskiene, <i>et al.</i> , 2018) |
| 70 | ferulic acid (tras- and cis- isomers) | Ft | (Hung & Morita, 2008; Y Liu, <i>et al.</i> , 2019; Sedej, <i>et al.</i> , 2012; Wefers & Bunzel, 2015; Xu, <i>et al.</i> , 2002) |
| 71 | gallic acid | Fd, Fe | (F Li, <i>et al.</i> , 2013; Y Liu, <i>et al.</i> , 2019; Park, <i>et al.</i> , 2019; Sytar, 2015; Terpinc, <i>et al.</i> , 2016; KJ Wang, <i>et al.</i> , 2005) |
| 72 | p-coumaric acid | Ft | (Sytar, 2015; Wefers & Bunzel, 2015; Xu, <i>et al.</i> , 2002) |
| 73 | p-hydroxybenzoic acid | Fd | (Y Liu, <i>et al.</i> , 2019; Tian & Xu, 1997) |
| 74 | Protocatechuic acid | Ft | (Y Liu, <i>et al.</i> , 2019; Sedej, <i>et al.</i> , 2012; Watanabe, <i>et al.</i> , 1997) |
| 75 | protocatechuic acid methyl ester | Fd | (Shao, <i>et al.</i> , 2005) |
| 76 | resveratrol | Fe | (Watanabe, <i>et al.</i> , 1997) |
| 77 | Sinapic acid | Ft | (Y Liu, <i>et al.</i> , 2019; Sedej, <i>et al.</i> , 2012; Wefers & Bunzel, 2015) |
| 78 | syringic acid | Ft | (XD Guo, <i>et al.</i> , 2011; Y Liu, <i>et al.</i> , 2019; Xu, <i>et al.</i> , 2002) |
| 79 | taroside (1,3,6,61-tetra-feruloyl sucrose) | Ft | (Ren, <i>et al.</i> , 2013) |
| 80 | tatariside A-G | Ft | (C Zheng, <i>et al.</i> , 2012) |
| 81 | vanillic acid | Ft | (Sedej, <i>et al.</i> , 2012; Xu, <i>et al.</i> , 2002) |
| 82 | Caffeic acid hexose | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 83 | 2-Hydroxy-3-O- <i>b</i> -Dglucopyranosyl-benzoic acid | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 84 | Methoxy-cinnamic acid | Fe, Ft | (Sytar, 2015) |
| 85 | Salicylic acid | Fe, Ft | (Sytar, 2015) |
| 86 | p-Anisic acid | Fe, Ft | (Sytar, 2015) |
| Flavonoids | | | |
| 87 | (-)epicatechin | Fe, Fd | (Kalinova, <i>et al.</i> , 2006; Park, <i>et al.</i> , 2019; Quettier-Deleu, <i>et al.</i> , 2000; Watanabe, <i>et al.</i> , 1997) |
| 88 | (-)epicatechin-3-O-(3,4-di-O-methyl)-gallate | Fe | (Vito Verardo, <i>et al.</i> , 2010; Watanabe, <i>et al.</i> , 1997) |
| 89 | (-)epicatechin-3-O-p-hydroxybenzoate | Fe | (Watanabe, <i>et al.</i> , 1997) |
| 90 | (+)-catechin | Fd | (Park, <i>et al.</i> , 2019; KJ Wang, <i>et al.</i> , 2005) |
| 91 | (+)-catechin-7-O-glucoside | | (Watanabe, <i>et al.</i> , 1997) |
| 92 | (3-methoxyphenyl)-2-piperidinemethanol | Fd | (Shao, <i>et al.</i> , 2005) |
| 93 | (Epi)afzelchine(epi)catechin isomer A | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 94 | (Epi)afzelchine(Epi)catechin isomer B | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 95 | (Epi)afzelchine(epi)catechin isomer C | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 96 | (Epi)afzelchine(epi)catechin isomer D | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 97 | 1-O-Caffeoyl-6-O-alpha-phaeanopyranosyl-beta-glycopyranoside (swertiamacroside) | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 98 | 3, 4-dihydroxy benzamine | Fd | (Shao, <i>et al.</i> , 2005) |
| 99 | 3,5-dimethylquercetin | Fd | (KJ Wang, <i>et al.</i> , 2005) |
| 100 | 3',4'-methylenedioxy-7-hydroxy-6-isopentenyl flavone | Fd | (Saxena, 1987) |
| 101 | 3-methylgossypetin-8-O- <i>D</i> -glucopyranoside | Fd | (KJ Wang, <i>et al.</i> , 2005) |
| 102 | 3-methylquercetin | Fd | (KJ Wang, <i>et al.</i> , 2005) |
| 103 | 5, 5'-di- α -furaldehyde dimethyl ester | Ft | (Tian & Xu, 1997) |
| 104 | 5,7,31,41-tetramethylquercetine-3-O-rutinoside | Ft | (Saxena, 1987) |
| 105 | 7-hydroxycoumarin | Ft | Sun, B.H et al, 2008 |

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| 106 | Apigenin | Fe | (Terpinc, <i>et al.</i> , 2016) |
| 107 | aromadendrin-3-O-D-galactoside | | (Watanabe, <i>et al.</i> , 1997) |
| 108 | Catechin-glucoside | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 109 | emodin | Fd | (Bao, <i>et al.</i> , 2003) |
| 110 | emodin-8-O-β D--glucopyranoside | Fd | Wang, K. et al, 2005 |
| 111 | Epiafzelchine epicatechin-O-methyl gallate | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 112 | Epiafzelchine-epicatechin-O-di methyl gallate | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 113 | Epicatechin-gallate | Fe | (Quettier-Deleu, <i>et al.</i> , 2000; Vito Verardo, <i>et al.</i> , 2010) |
| 114 | fagopyrin | Fe, Ft | (Habtemariam, 2019; Kreft, <i>et al.</i> , 2013) |
| 115 | fructose | Ft | (KJ Wang, <i>et al.</i> , 2005) |
| 116 | hesperidin | Fd | (Wu, <i>et al.</i> , 2008) |
| 117 | hyperin/isoquercitrin (quercetin-3-O-glucoside) | Fe | (Ren, <i>et al.</i> , 2013; Watanabe, <i>et al.</i> , 1997) |
| 118 | isoorientin | Fe, Ft | (T Chen, <i>et al.</i> , 2020; HJ Kim, <i>et al.</i> , 2011; SJ Kim, <i>et al.</i> , 2008; Kraujaliene, <i>et al.</i> , 2017; Nam, <i>et al.</i> , 2015; Pankaja, 2011) |
| 119 | isovitexin | Fe, Ft | (T Chen, <i>et al.</i> , 2020; Dietarych-Szostak & Oleszek, 1999; SJ Kim, <i>et al.</i> , 2008; Nam, <i>et al.</i> , 2015; Pankaja, 2011) |
| 120 | kaempferol | Fd, Ft | (Jiang, <i>et al.</i> , 2015; JM Lee, <i>et al.</i> , 2013; Terpinc, <i>et al.</i> , 2016) |
| 121 | kaempferol-3-O-galactoside | Ft | (Bao, <i>et al.</i> , 2003; Jiang, <i>et al.</i> , 2015; KJ Wang, <i>et al.</i> , 2005) |
| 122 | kaempferol-3-O-glucoside | Ft | (Bao, <i>et al.</i> , 2003; Jiang, <i>et al.</i> , 2015; KJ Wang, <i>et al.</i> , 2005) |
| 123 | kaempferol-3-O-glucoside-7-O-glucoside | Fe | (Watanabe, <i>et al.</i> , 1997) |
| 124 | kaempferol-3-O-rutinoside | Ft | (Bao, <i>et al.</i> , 2003; Jiang, <i>et al.</i> , 2015; KJ Wang, <i>et al.</i> , 2005) |
| 125 | kaempferol-3-O-sophoroside | Fe | (Watanabe, <i>et al.</i> , 1997) |
| 126 | luteolin | Fd | (Shao, <i>et al.</i> , 2005; Terpinc, <i>et al.</i> , 2016) |
| 127 | Luteolin-glycosid | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 128 | myricetin | Fe, Fd | (Kalinova, <i>et al.</i> , 2006) |
| 129 | naringenin | Fe | (Pankaja, 2011; Terpinc, <i>et al.</i> , 2016) |
| 130 | n-butyl-β-D-fructopyranoside | Fd | (Shao, <i>et al.</i> , 2005) |
| 131 | N-trans-feruloyltyramine | Ft | (Ren, <i>et al.</i> , 2013) |
| 132 | orientin | Fe, Ft | (T Chen, <i>et al.</i> , 2020; HJ Kim, <i>et al.</i> , 2011; SJ Kim, <i>et al.</i> , 2008; Nam, <i>et al.</i> , 2015) |
| 133 | Procyanidin B2 | Fe | (Vito Verardo, <i>et al.</i> , 2010); (Quettier-Deleu, <i>et al.</i> , 2000) |
| 134 | Procyanidin B2 dimethyl gallate | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 135 | Procyanidin B2-3-O-gallate | Fe | (Vito Verardo, <i>et al.</i> , 2010) |
| 136 | Quercetin | Ft | (T Chen, <i>et al.</i> , 2020 ; Ge & Wang, 2020; Kočevar Glavač, <i>et al.</i> , 2017; JM Lee, <i>et al.</i> , 2013; Sadauskienė, <i>et al.</i> , 2018; Sedej, <i>et al.</i> , 2012; Terpinc, <i>et al.</i> , 2016; Vito Verardo, <i>et al.</i> , 2010) |
| 137 | quercetin-3-O-(211-O-p-hydroxy-coumaroyl)-glucoside | Fd | (KJ Wang, <i>et al.</i> , 2005); |
| 138 | quercetin-3-O-[_D-xyloxyl-(1Ñ2)-L-rhamnoside] | Ft | (Ren, <i>et al.</i> , 2013) |
| 139 | quercetin-3-O-_D-galactoside | Ft, Fe | (Nam, <i>et al.</i> , 2015; Ren, <i>et al.</i> , 2013; Watanabe, <i>et al.</i> , 1997) |
| 140 | quercetin-3-O-rutinoside-31-O-_-glucopyranoside | Fd, Ft | (Wu, <i>et al.</i> , 2008) |
| 141 | quercetin-3-O-rutinoside-7-O-galactoside | Ft | (Saxena, 1987) |
| 142 | quercitrin (quercetin-3-O-rhamnoside) | Fd, Ft | (Ren, <i>et al.</i> , 2013; KJ Wang, <i>et al.</i> , 2005) |
| 143 | rhamnetin | Fd | (Wu, <i>et al.</i> , 2008) |
| 144 | rutin | Fd, Fe, Ft | (T Chen, <i>et al.</i> , 2020 ; Dietarych-Szostak & Oleszek, 1999; Fabjan, <i>et al.</i> , 2003; Ge & Wang, 2020 ; XD Guo, <i>et al.</i> , 2011; Habtemariam, 2019; Holasovaa, <i>et al.</i> , 2002; Hung & Morita, 2008; Kalinova, <i>et al.</i> , 2006; Keriene, <i>et al.</i> , 2015 ; HJ Kim, <i>et al.</i> , 2011; Kočevar Glavač, <i>et al.</i> , 2017; Kraujaliene, <i>et al.</i> , 2017; Kreft, <i>et al.</i> , 1999; Nam, <i>et al.</i> , 2015; B. Dave Oomah & Giuseppe Mazza, 1996; Park, <i>et al.</i> , 2019; Quettier-Deleu, <i>et al.</i> , 2000; Sadauskienė, <i>et al.</i> , 2018; Sedej, <i>et al.</i> , 2012; KJ Wang, <i>et al.</i> , 2005) |

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| 145 | squalene | Fe | (F Zheng, <i>et al.</i> , 2004) |
| 146 | succinic acid | Fd | (Tian & Xu, 1997) |
| 147 | sucrose | Ft | (KJ Wang, <i>et al.</i> , 2005) |
| 148 | taxifolin-3-O-D-xyloside | Fe | (Watanabe, <i>et al.</i> , 1997) |
| 149 | uracil | Ft | (Bao, <i>et al.</i> , 2003) |
| 150 | vitexin | Fe, Ft | (T Chen, <i>et al.</i> , 2020; HJ Kim, <i>et al.</i> , 2011; SJ Kim, <i>et al.</i> , 2008; Nam, <i>et al.</i> , 2015; Pankaja, 2011) |
| Vitamins | | | |
| 151 | A (β -carotene) | Fe, Ft,Fd | (Gabrovská, <i>et al.</i> , 2002) |
| 152 | B1 (thiamine) | Fe, Ft,Fd | (Bonafaccia, <i>et al.</i> , 2003) |
| 153 | B2 (riboflavin) | Fe, Ft,Fd | (Bonafaccia, <i>et al.</i> , 2003) |
| 154 | B5 (pantothenic acid) | Fe, Ft,Fd | (Gabrovská, <i>et al.</i> , 2002) |
| 155 | B6 (pyridoxine) | Fe, Ft,Fd | (Bonafaccia, <i>et al.</i> , 2003) |
| 156 | C (ascorbic acid) | Fe, Ft,Fd | (Lintschinger, <i>et al.</i> , 1997) |
| 157 | E (tocopherols) | Fe, Ft,Fd | (SL Kim, Kim, S. K., and Park, C. H., 2002) |
| 158 | Alpha-tocopherol | Fe | (Sedej, <i>et al.</i> , 2012) |
| 159 | Beta-tocopherol | Fe | (Sedej, <i>et al.</i> , 2012) |
| 160 | Gamma-tocopherol | Fe | (Sedej, <i>et al.</i> , 2012; F Zheng, <i>et al.</i> , 2004) |
| Minerals | | | |
| 161 | Boron | Fe | (Ikeda, <i>et al.</i> , 2006; Steadman, <i>et al.</i> , 2001) |
| 162 | Calcium | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2005; Q Zhang & Xu, 2017) |
| 163 | Copper | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2005; Q Zhang & Xu, 2017) |
| 164 | Iron | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2002; Q Zhang & Xu, 2017) |
| 165 | Magnesium | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2005) |
| 166 | Manganese | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2005; Q Zhang & Xu, 2017) |
| 167 | Phosphorus | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2005; Q Zhang & Xu, 2017) |
| 168 | Potassium | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2005) |
| 169 | Zinc | Fe, Ft,Fd | (Ikeda, <i>et al.</i> , 2005; Q Zhang & Xu, 2017) |
| Protein | | | |
| 170 | Albumin | Ft | (X Guo, <i>et al.</i> , 2007; Siwatch, <i>et al.</i> , 2019) |
| 171 | Globulin | Ft | (X Guo, <i>et al.</i> , 2007) |
| 172 | Prolamin | Ft | (X Guo, <i>et al.</i> , 2007) |
| 173 | Glutelin | Ft | (X Guo, <i>et al.</i> , 2007) |
| 174 | TBPC or TBP | Ft | (C Zhang, <i>et al.</i> , 2005; Z Zhang, <i>et al.</i> , 1999) |
| 175 | TBWSP31 | Ft | (X Guo, <i>et al.</i> , 2007) |
| 176 | TBTI | Ft | (Z Wang, <i>et al.</i> , 2004) |
| 177 | DTPF | Ft | (CH Li, <i>et al.</i> , 2002) |
| 178 | TBa, TBb, TBt | Ft | (Z Wang, <i>et al.</i> , 2006) |

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Figure 1. Flowchart of studies included in current review

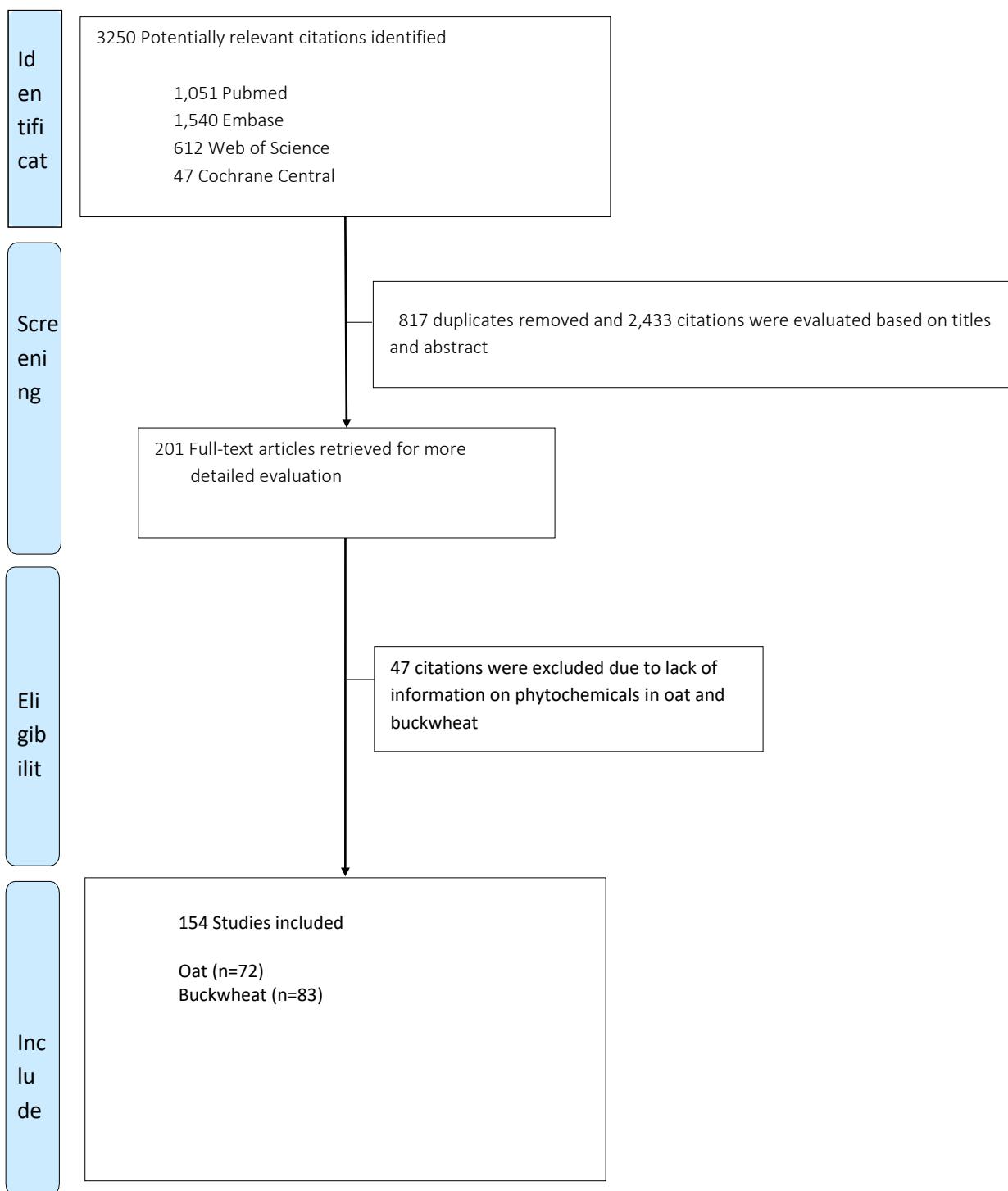
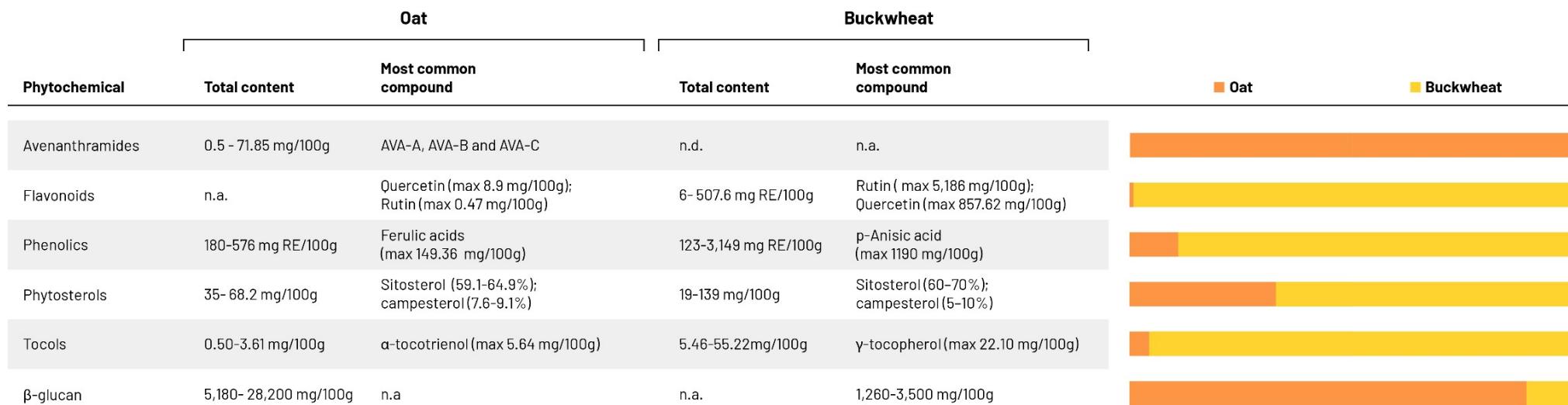


Figure 2. Illustrative summary of the most important findings



The orange and yellow bars present maximal phytochemical content reported in oat vs. maximal phytochemical content reported in buckwheat. For example, for total phenolics, the orange bar illustrates the maximal reported total phenolic content in oat (576 mg RE/100g) and the yellow bar represents the max reported phenolic content in buckwheat (3,149 mg RE/100g).

Abbreviations: AVA-A, AVA-B and AVA-C: Esters of 5-hydroxyanthranilic acid with p-coumaric (AVA-A), caffeic (AVA-B) and ferulic acids (AVA-C); n.a.: not available; n.d.: not detected; RE: rutin equivalents

| Supplemental table 1. Search strategy used in current review |
|--|
| Embase.com ('metabolism'/exp OR 'metabolomics'/exp OR 'energy metabolism'/exp OR 'metabolic activity assay'/de OR 'phytochemistry'/de OR 'phytochemical'/exp OR 'nutrient content'/de OR 'nutrient'/exp OR 'nutraceutical'/exp OR 'diet supplementation'/de OR 'pharmacokinetics'/exp OR (metabol* OR cometabol* OR co-metabol* OR nutrient* OR nutraceut* OR phytochem* OR phytopharmaceut* OR pharmacokinetic* OR ((dietary OR nutritional) NEAR/3 (supplement*)):ab,ti) OR ('alkaloid'/exp OR 'amine'/exp OR 'amino acid'/exp OR 'carbohydrate'/exp OR 'carotenoid'/exp OR 'disaccharide'/exp OR 'fatty acid'/exp OR 'flavonoid'/exp OR 'indole derivative'/exp OR 'lignan'/exp OR 'lipid'/exp OR 'monosaccharide'/exp OR 'peptide'/exp OR 'polysaccharide'/exp OR 'protein'/exp OR 'purine derivative'/exp OR 'pyrimidine derivative'/exp OR 'stilbene derivative'/de OR 'sugar alcohol'/exp OR 'terpene'/de OR 'amide'/de OR 'avenanthramide'/exp OR ("Amino acid*" OR "Cyanogenic glucoside*" OR "Fatty acid*" OR "Nucleic acid base*" OR "Organic acid*" OR "Organosulfur compound*" OR "Phenolic acid*" OR "Sugar alcohol*" OR Alkaloid* OR Amine* OR Benzenoid* OR Carotenoid* OR Chlorophyll* OR Disaccharide* OR Flavonoid* OR Indole* OR Ligan* OR Monosaccharide* OR Peptide* OR Polyacetylene* OR Polysaccharide* OR Protein* OR Purine* OR Pyrimidine* OR Stilbene* OR Terpene* OR Terpenoid* OR avenanthramid* OR amide*):ab,ti) AND ('plant extract'/de OR 'plant medicinal product'/de OR 'nutrient content'/de OR 'chromatography'/exp OR 'chemistry'/exp OR (chromatogra* OR electrochromatogra* OR ((plant OR plants) NEAR/3 (extract* OR biochem* OR preparation* OR medicinal*)):ab,ti) AND ('buckwheat'/de OR 'fagopyrum'/exp OR 'oat'/de OR 'oat bran'/de OR (buckwheat* OR fagopyrum OR 'avena sativa' OR 'avena nuda' OR avena OR avenas OR ((oat OR oats) NEAR/3 (plant* OR hull* OR bran* OR kernel* OR groat*)):ab,ti) NOT ([Conference Abstract]/lim OR [Letter]/lim OR [Note]/lim OR [Editorial]/lim) |
| Web of Science (Core collection) TS=((metabol* OR cometabol* OR co-metabol* OR nutrient* OR nutraceut* OR phytochem* OR phytopharmaceut* OR pharmacokinetic* OR ((dietary OR nutritional) NEAR/2 (supplement*))) OR "Amino acid*" OR "Cyanogenic glucosid*" OR "Fatty acid*" OR "Nucleic acid base*" OR "Organic acid*" OR "Organosulfur compound*" OR "Phenolic acid*" OR "Sugar alcohol*" OR Alkaloid* OR Alkane* OR Amine* OR Benzenoid* OR Carotenoid* OR Chlorophyll* OR Disaccharide* OR Flavonoid* OR Indole* OR Ligan* OR Monosaccharide* OR Peptide* OR Polyacetylene* OR Polysaccharide* OR Protein* OR Purine* OR Pyrimidine* OR Stilbene* OR Terpene* OR Terpenoid* OR avenanthramid* OR amide*) AND (chromatogra* OR electrochromatogra* OR ((plant OR plants) NEAR/3 (extract* OR biochem* OR preparation* OR medicinal*)))) AND (buckwheat* OR fagopyrum OR "avena sativa" OR "avena nuda" OR avena OR avenas OR ((oat OR oats) NEAR/2 (plant* OR hull* OR bran* OR kernel* OR groat*))) AND DT=(article) |
| Cochrane (metabol* OR cometabol* OR co-metabol* OR nutrient* OR nutraceut* OR phytochem* OR phytopharmaceut* OR pharmacokinetic* OR ((dietary OR nutritional) NEAR/3 (supplement*))) OR "Amino acids" OR "Amino acid" OR "Cyanogenic glucoside" OR "Cyanogenic glucosides" OR "Fatty acids" OR "Fatty acid" OR "Nucleic acid base" OR "Nucleic acid bases" OR "Nucleic acid based" OR "Organic acid" OR "Organic acids" OR "Organosulfur compound" OR "Organosulfur compounds" OR "Phenolic acids" OR "Phenolic acid" OR "Sugar alcohol" OR "Sugar alcohols" OR Alkaloid* OR Alkane* OR Amine* OR Benzenoid* OR Carotenoid* OR Chlorophyll* OR Disaccharide* OR Flavonoid* OR Indole* OR Ligan* OR Monosaccharide* OR Peptide* OR Polyacetylene* OR Polysaccharide* OR Protein* OR Purine* OR Pyrimidine* OR Stilbene* OR Terpene* OR Terpenoid* OR avenanthramid* OR amide*) AND (chromatogra* OR electrochromatogra* OR ((plant OR plants) NEAR/3 (extract* OR biochem* OR preparation* OR medicinal*))) AND (buckwheat* OR fagopyrum "avena sativa" OR "avena nuda" OR avena OR avenas OR ((oat OR oats) NEAR/3 (plant* OR hull* OR bran* OR kernel* OR groat*))) |
| PubMed (((("Metabolism"[mh] OR "Metabolomics"[mh] OR "Energy Metabolism"[mh] OR "Phytochemicals"[mh] OR "Nutrients"[mh] OR "Dietary Supplements"[mh] OR "Pharmacokinetics"[mh] OR metabol*[tiab] OR cometabol*[tiab] OR co-metabol*[tiab] OR nutrient*[tiab] OR nutraceut*[tiab] OR phytochem*[tiab] OR phytopharmaceut*[tiab] OR pharmacokinetic*[tiab] OR ((dietary[tiab] OR nutritional[tiab]) AND (supplement*[tiab]))) OR ("Alkaloids"[mh] OR "Amines"[mh] OR "Amino acids"[mh] OR "Carbohydrates"[mh] OR "Carotenoids"[mh] OR "Disaccharides"[mh] OR "Fatty Acids"[mh] OR "Flavonoids"[mh] OR "Indoles"[mh] OR "Lignans"[mh] OR "Lipids"[mh] OR "Monosaccharides"[mh] OR "Peptides"[mh] OR "Polysaccharides"[mh] OR "Proteins"[mh] OR "Purines"[mh] OR "Pyrimidines"[mh] OR "Stilbenes"[mh] OR "Sugar Alcohols"[mh] OR "Terpenes"[mh] OR "Amides"[mh] OR Amino acid*[tiab] OR Cyanogenic glucoside*[tiab] OR Fatty acid*[tiab] OR Nucleic acid base*[tiab] OR Organic acid*[tiab] OR Organosulfur compound*[tiab] OR Phenolic acid*[tiab] OR Sugar alcohol*[tiab] OR Alkaloid*[tiab] OR Alkane*[tiab] OR Amine*[tiab] OR Benzenoid*[tiab] OR Carotenoid*[tiab] OR Chlorophyll*[tiab] OR Disaccharide*[tiab] OR Flavonoid*[tiab] OR Indole*[tiab] OR Ligan*[tiab] OR Monosaccharide*[tiab] OR Peptide*[tiab] OR Polyacetylene*[tiab] OR Polysaccharide*[tiab] OR Protein[tiab] OR Proteins[tiab] OR Purine*[tiab] OR Pyrimidine*[tiab] OR Stilbene*[tiab] OR Terpene*[tiab] OR Terpenoid*[tiab] OR avenanthramide*[tiab] OR amide*[tiab])) AND ((("Plant Extracts"[mh] OR "Chromatography, Liquid"[Mesh] OR chromatogra*[tiab] OR electrochromatogra*[tiab] OR ((plant[tiab] OR plants[tiab]) AND (extract*[tiab] OR biochem*[tiab] OR preparation*[tiab] OR medicinal*[tiab]))) AND ("Fagopyrum"[mh] OR buckwheat*[tiab] OR fagopyrum[tiab] OR "Avena"[mh] OR avena sativa[tiab] OR avena nuda[tiab] OR avena[tiab] OR avenas[tiab] OR ((oat[tiab] OR oats[tiab]) AND (plant[tiab] OR plants[tiab] OR hull*[tiab] OR bran[tiab] OR brans[tiab] OR kernel*[tiab] OR groat*[tiab]))) NOT (letter[pt] OR news[pt] OR comment[pt] OR editorial[pt] OR congress[pt]))) |

Supplemental table 2. Flavonoids, phenolic compounds, AVAs in oat and buckwheat

| Flavonoids in oat and buckwheat | | | | |
|---------------------------------|---|-------------------------------------|-------------------------------|--|
| Compound | Plant and specie (or cultivar) | Plant part | Concentration | Publication |
| Total flavonoids | Tartary Buckwheat | Seeds | 0.037 % | (Jiang, <i>et al.</i> , 2007) |
| | Buckwheat | Whole grain | 7mg RE/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | Hull | 17mg RE/g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | groat | 6 mg RE/100g | (Sedej, <i>et al.</i> , 2012) |
| | Common Buckwheat | Seeds | 2.038 % | (Jiang, <i>et al.</i> , 2007) |
| | Common Buckwheat | Sprouts | 507.6 mg RE/ 100g | (Chen, <i>et al.</i> , 2020) |
| | Common Buckwheat | Seed and hull | 371.5- 1463.7 mg/100g | (Oomah & Mazza, 1996) |
| | Common buckwheat | groats | 170 mg RE/100g | (Tien, <i>et al.</i> , 2018) |
| | Tartary buckwheat | groats | 1434 mg RE/100g | (Tien, <i>et al.</i> , 2018) |
| Isoorientin | Common Buckwheat | Grain | 0.15-7.61 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| | Common Buckwheat | Sprouts, microgreens, leafy greens | 751.53 mg/100g | (Sharma, 2011) |
| Orientin | Common Buckwheat | Sprouts, microgreens, leafy greeens | 353.25 mg/100g | (Sharma, 2011) |
| Apigenin | Common Buckwheat | Grain | 0.05-0.24 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| Fagopyrin | Common and Tartary Buckwheat | Leaves, flowers | 19-32 mg/100g | (Habtemariam, 2019) |
| | Tartary buckwheat | All parts | 3.06- 144.6 mg/100g | (Kočevar Glavač, <i>et al.</i> , 2017) |
| | Common Buckwheat | Sprouts | 0.0025 to 0.041 % of dry mass | (Kreft, 2013) |
| | Tartary Buckwheat | | 0.10 to 0.12 %. | (Kreft, 2013) |
| Kaempferol-3-O-rutinoside | Buckwheat Daesan maemil | Seeds | 3.3 mg/100g | (Lee, <i>et al.</i> , 2013) |
| | Buckwheat Yangjul maemil | Seeds | 3.2 mg/100g | (Lee, <i>et al.</i> , 2013) |
| | Tartary Buckwheat | Seeds | 8.2 mg/100g | (Lee, <i>et al.</i> , 2013) |
| Kaempferol | Tartary Buckwheat Chuanqiao 1 &2, Xiqiao 3 | flour | 1-3 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | bran | 2-4 mg/100g | (Peng L., 2017) |
| | Buckwheat | Hull, Groat | 0.02 mg/100g | (Dziedzic, <i>et al.</i> , 2009) |
| | Tartary Buckwheat | Flowers, Leaves, Stalk, roots | 0.14-0.33 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| Quercetin | Oat (Mina DS) | germ, endosperm | 2.4-8.9 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Mina DS) | husks | 3.76-8.82 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | germ, endosperm | 1.22-5.16 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | husks | 0.27-4.83 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Buckwheat | grain with husks | 0.31-0.67 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Buckwheat | husks | 0.28–0.41 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | flour | 24-72 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | bran | 62-111 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat (Kitawase, Hokkai T8, T9, T10) | Sprouts | 1.3-47 mg/100g | (Arasu, <i>et al.</i> , 2014) |
| | Common Buckwheat/ Tartary Buckwheat | Bran | 12.7-13.0 mg/100g | (Bai, <i>et al.</i> , 2015) |
| | Buckwheat | Hull, Groat | 0.02-0.59 mg/100g | (Dziedzic, <i>et al.</i> , 2009) |
| | Tartary Buckwheat | Flowers, leaves, Stalk, roots | 0.21-84.5 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Common Buckwheat | Hull | 0.02-0.07 mg/100g | (Kalinova, <i>et al.</i> , 2019) |
| | Common Buckwheat/ Tartary Buckwheat (Kitawase, Hokkai T9) | Seeds, Sprouts | 10 mg/100g | (Kim, <i>et al.</i> , 2008) |
| | Common Buckwheat | Hull | 0.61 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| | Common Buckwheat | Flour | 0.15 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| | Common Buckwheat | Sprouts | 33 mg/100 g | (Chen, <i>et al.</i> , 2020) |
| | Tartary buckwheat | Seed | 425.65-857.62mg/100g | (Guo, 2011 #156) |

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| | Tartary Buckwheat | Bran | 330 mg/100g | (Ge & Wang, 2020) |
| Quercetin | Common buckwheat | Hulls, flour | 0.15-0.61 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| | Tartary Buckwheat | All parts | 0.82 mg/100g | (Kočevar Glavač, <i>et al.</i> , 2017) |
| | Common Buckwheat | Grain | 1.19-7.69 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| | Common Buckwheat | Sprouts, microgreens, leafy greens | 17.12 mg/100g | (Sharma, 2011) |
| | Tartary buckwheat | Groats | 116 mg/100g | (Tien, <i>et al.</i> , 2018) |
| | Hyperoside | Common buckwheat | 0.2-1.6 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| Luteolin | Common Buckwheat | Grain | 0.33-4.13 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| Kaempferol | Common Buckwheat | Grain | 0.1-0.29 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| Naringenin | Common Buckwheat | Grain | 0.13-0.60 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| Quercitrin | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | flour | 43-68 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | bran | 146-291 mg/100g | (Peng L., 2017) |
| Rutin | Buckwheat | Grain with husks | 14.7-40.6 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Common Buckwheat | Seed and hull | 44.2-85.3 mg/100g | (Oomah & Mazza, 1996) |
| | Buckwheat | husks | 11.3-13.98 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Husked oat | Grain without husks | n.d. | (Keriene, <i>et al.</i> , 2015) |
| | Husked oat | husks | 0.00-3.02 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Oat | naked | 0.22-0.47 mg/100g | {Tong, 2014 #155} |
| | Common oat | Grain without husks | n.d. | (Keriene, <i>et al.</i> , 2015) |
| | Common oat | husks | n.d. | (Keriene, <i>et al.</i> , 2015) |
| | Tartary Buckwheat Ishisoba | grain | 1193 mg/100g | (Andrea Brunori, 2009) |
| | Tartary Buckwheat golden | grain | 1041mg/100g | (Andrea Brunori, 2009) |
| | Tartary Buckwheat Donan | grain | 979 mg/100g | (Andrea Brunori, 2009) |
| | Common buckwheat | hull | 80-440 mg/100g | (Steadman, <i>et al.</i> , 2001) |
| | Common Buckwheat | Sprouts, microgreens, leafy greens | 1440.92 mg/100g | (Sharma, 2011) |
| | Common Buckwheat | Bran | 20-30 mg/100g | (Steadman, <i>et al.</i> , 2001) |
| | Common Buckwheat | groat | 18 mg/100g | (Steadman, <i>et al.</i> , 2001) |
| | Tartary Buckwheat | groat | 84 mg/100g | (Steadman, <i>et al.</i> , 2001) |
| | Common Buckwheat | hulls | 84 mg/100g | (Steadman, <i>et al.</i> , 2001) |
| | Tartary Buckwheat | hulls | 437 mg/100g | (Steadman, <i>et al.</i> , 2001) |
| | Buckwheat | whole grain | 14.6 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | hull | 22.5 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | groat | 11.6 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat Daesan maemil | Seeds | 45.0 mg/100g | (Lee, <i>et al.</i> , 2013) |
| | Buckwheat Yangjul maemil | Seeds | 26.6 mg/100g | (Lee, <i>et al.</i> , 2013) |
| | Tartary Buckwheat | Seeds | 204.0 mg/100g | (Lee, <i>et al.</i> , 2013) |
| | Tartary Buckwheat | seeds | 810-1700 mg/100g | (Fabjan, <i>et al.</i> , 2003) |
| | Common Buckwheat | seeds | 10mg/100g | (Fabjan, <i>et al.</i> , 2003) |
| | Tartary Buckwheat | Flower, leaf, Stalk | 52.38-294.9 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Common/Tartary Buckwheat | Flower. leaf, stalk, seed | 0.42-7.77% ^a | (Zielinska, <i>et al.</i> , 2012) |
| | Tartary Buckwheat (Kitawase, Hokkai T8, T9, T10) | Sprouts | 329-4793 mg/100g | (Arasu, <i>et al.</i> , 2014) |
| | Tartary Buckwheat/ Common Buckwheat | Bran | 0.33 mg/100g | (Bai, <i>et al.</i> , 2015) |
| | Common Buckwheat/Tartary Buckwheat (Kitawase, Hokkai T9) | Seeds, sprouts | 20-2380 mg/100g | (Kim, <i>et al.</i> , 2008) |
| | Common Buckwheat | Sprouts | 719 mg/ 100g | (Chen, <i>et al.</i> , 2020) |
| | Common Buckwheat | Flour | 12.7 mg/100g | (Danila, <i>et al.</i> , 2007) |
| | Buckwheat | Hull, Groat | 0.7-3.59 mg/100g | (Dziedzic, <i>et al.</i> , 2009) |
| | Common Buckwheat | Seeds | 1400-18850 mg/100g | (A. R. Gulpinar, <i>et al.</i> , 2012) |
| | Common Buckwheat | Hull | 0.76-0.98 mg/100g | (Kalinova, <i>et al.</i> , 2019) |
| | Common Buckwheat | Hull | 5.21 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| | Common Buckwheat | Flour | 2.28 mg/ 100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| | Husked oat | husks | 0.00-3.02 mg/100g | (Keriene, <i>et al.</i> , 2015) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 849-1486 mg/100g | (Peng L., 2017) |
| | Tartary buckwheat | Seed | 518.54-1325.59 mg/100g | {Guo, 2011 #156} |
| | Tartary Buckwheat | Bran | 4079-5186mg/100g | (Peng L., 2017) |

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|---------------------|---|--|---|--|
| | Chuanqiao 1&2, Xiqiao 3 | | | |
| | Tartary Buckwheat | Bran | 332.9 mg/100g | (Ge & Wang, 2020) |
| | Common Buckwheat | Leaves, flowers | 822-3417 mg/100g | (Habtemariam, 2019) |
| | Common Buckwheat | Flowers | 568 mg/100g | (Kraujaliene, <i>et al.</i> , 2017) |
| | Common Buckwheat | Seeds | 54.2 mg/ 100g | (Park, <i>et al.</i> , 2019) |
| Rutin | Tartary Buckwheat | All parts | 157-3245mg/100g | (Kočevar Glavač, <i>et al.</i> , 2017) |
| | Common Buckwheat | Grains | 0.25-33.0 mg/100 g | (Hung & Morita, 2008) |
| | Common buckwheat | Hulls, flour | 2.28- 5.205 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| Epicatechin | Common buckwheat | Hulls, flour | 1.15-3.4 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| Epicatechin gallate | Common buckwheat | Hulls, flour | 0.88 mg/100g | (Quettier-Deleu, <i>et al.</i> , 2000) |
| Catechin | Tartary buckwheat | Seed | 8.89-19.96 mg/100g | {Guo, 2011 #156} |
| Phenolics | | | | |
| Compound | Plant | Plant part | Concentration | Author |
| Total phenolics | Oat (Mina DS) | Germ, endosperm | 180 mg RE/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Mina DS) | Hull (or husks) | 265 mg RE/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | Germ, endosperm | 286 mg RE/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | Hull (or husks) | 576 mg RE/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 35.1-87.4 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Ogle) | Germ, endosperm, bran, hull | 23.2 mg/100g | (Xing & White, 1997) |
| | Oat (Ogle) | Hull | 35.1 mg/100g | (Xing & White, 1997) |
| | Oat (Wild oat, SH430, M73) | Germ, endosperm, bran, hull | 0.14-0.16 mg (per seed) | (Gallagher, <i>et al.</i> , 2010) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 3.57-14.35 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 120.1-168.4 mg/100g | (Multari, <i>et al.</i> , 2018) |
| | Common Buckwheat | grain with husks | 1020 mg RE/100g | (Keriene, <i>et al.</i> , 2015) |
| | Common Buckwheat | husks | 1410 mg RE/100g | (Keriene, <i>et al.</i> , 2015) |
| | Oat (commercial) | Bran | 2.52 mg/100g | (Čălinoiu & Vodnar, 2020) |
| | Oat (commercial), thermally processed | Bran | 3.17 mg/100g | (Čălinoiu & Vodnar, 2020) |
| | Oat (22 commercial varieties) | Seeds and bran | 64.5-151.8 mg/100 g | (Soycan, <i>et al.</i> , 2019) |
| | Oat | | 113.8 mg GAE/100g | (Holasovaa, <i>et al.</i> , 2002) |
| | Buckwheat | seeds | 330.3 GAE/100g | (Holasovaa, <i>et al.</i> , 2002) |
| | uckwheat | Dehulled seeds | 390.3 GAE/100g | (Holasovaa, <i>et al.</i> , 2002) |
| | uckwheat | leaves | 3.951.4 mg GAE/100g | (Holasovaa, <i>et al.</i> , 2002) |
| | Common Buckwheat | groat | 244 mg/100g**** | (Steadman, <i>et al.</i> , 2001) |
| | Common Buckwheat | whole grain | 142 mg/100g*** | (Sedej, <i>et al.</i> , 2012) |
| | Common Buckwheat | hull | 220 mg/100g*** | (Sedej, <i>et al.</i> , 2012) |
| | Common Buckwheat | groat | 141 mg/100g*** | (Sedej, <i>et al.</i> , 2012) |
| | Common Buckwheat | Seed milling fractions | 1548 mg/100g**** | (Steadman, <i>et al.</i> , 2001) |
| | Common Buckwheat | Seed, steam, aerial parts | 9030-30100 mg/100g*** | (A. R. Gulpinar, <i>et al.</i> , 2012) |
| | Common Buckwheat | Sprouts | 778.6 mg/ 100g*** | (Chen, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Bran, flour | 123 mg RE/ 100g | (Ge & Wang, 2020) |
| | Common Buckwheat | Seeds | 537 mg GAE/ 100g | (Liu, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | Seeds | 667 mg GAE/100g | (Liu, <i>et al.</i> , 2019) |
| | Common Buckwheat | Seeds | 177.7 mg/100g | (Rocchetti, <i>et al.</i> , 2019) |
| | Common Buckwheat | Seeds | 1495 mg/100g | (Siwatch, <i>et al.</i> , 2019) |
| | Common buckwheat | Seeds, Sprouts | 64.5-670 mg/100g** | (Alvarez-Jubete, <i>et al.</i> , 2010) |
| | Common buckwheat | groats | 773 mg FAE/100g | (Tien, <i>et al.</i> , 2018) |
| | Tartary buckwheat | groats | 1927 mg FAE/100g | (Tien, <i>et al.</i> , 2018) |
| | Common buckwheat | Hull, seed, dehulled seed | 280- 513.18 chlorogenic acid equivalents/100g | (Dziadek, <i>et al.</i> , 2016) |
| | Oat | naked | 101.7 to 151.9 mg/100g | {Tong, 2014 #155} |
| | Common buckwheat | hulls, brans and flour | 1386-2487 GAE mg/100g | (Li, <i>et al.</i> , 2013) |
| 4-hydrobenzoic acid | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.62-5.06 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Wild oat, SH430, M73) | Germ, endosperm, bran, hull | 0.0004-0.0007 mg (per seed) | (Gallagher, <i>et al.</i> , 2010) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.67-2.37 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (22 commercial varieties) | Seeds and bran | 0.2-1.55 mg/100 g | (Soycan, <i>et al.</i> , 2019) |
| | Oat | bran | 2.2 mg/1006 | (Mattila, <i>et al.</i> , 2005) |
| | Oat (20 varieties) | Seeds | 0.54 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat (20 varieties) | Hull | 2.25 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Tartary Buckwheat | Flowers, leaves, stalk, | 0.07-0.14 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |

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|------------------|--|--|-----------------------------|-------------------------------------|
| | | roots | | |
| | Tartary buckwheat | Seed | 2.22- 8.78 mg/100g | {Guo, 2011 #156} |
| gallic acid | Buckwheat | Hull, Groat | 0.02-0.17 mg/100g | (Dziedzic, <i>et al.</i> , 2009) |
| | Tartary Buckwheat | Flower, leaf, root | 0.08-0.73 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 1.43-7.05 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Common Buckwheat | Seeds | 0.28 mg/100g | (Liu, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | Seeds | 0.65 mg/100g | (Liu, <i>et al.</i> , 2019) |
| | Common Buckwheat | Seeds | 0.98 mg/100g | (Park, <i>et al.</i> , 2019) |
| | Buckwheat | seed | 0.48-0.62 mg/100g | {Guo, 2011 #156} |
| Chlorogenic acid | Common Buckwheat | Grain | 0.07-0.19 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| | Tartary Buckwheat | Flower, leaf, root | 0.21-101.34 g/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Oat | naked | 0.20 mg/100g | {Tong, 2014 #155} |
| | Tartary Buckwheat (Kitawase, Hokkai T8, T9, T10) | Sprouts | 162-377mg/100g | (Arasu, <i>et al.</i> , 2014) |
| | Tartary Buckwheat | Flowers, Leaves, stalk, roots | 2.13-101 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Common Buckwheat/Tartary Buckwheat (Kitawase, Hokkai T9) | Seeds, sprouts | 80-170 mg/100g | (Kim, <i>et al.</i> , 2008) |
| | Common Buckwheat | Seeds | 0.26-1.26 mg/100g | (Kiprovski, <i>et al.</i> , 2015) |
| | Common Buckwheat | Sprouts, microgreens, leafy greens | 156.23 mg/100g | (Sharma, 2011) |
| | Common Buckwheat | Flowers | 124.7 mg/100g | (Kraujaliene, <i>et al.</i> , 2017) |
| | Common Buckwheat | Seeds | 1.15 mg/100g | (Liu, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | Seeds | 0.57 mg/100g | (Liu, <i>et al.</i> , 2019) |
| | Common Buckwheat | Seeds | 11.0 mg/100g | (Park, <i>et al.</i> , 2019) |
| vanillic acid | Common and tartary buckwheat | | 3.1-16.6 mg/100g | (Sytar, 2014) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.39-9.38 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Mina DS) | Germ, endosperm | 0.26 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat | bran | 0.4 mg/100g | (Mattila, <i>et al.</i> , 2005) |
| | Oat (Mina DS) | Hull (or husks) | 1.12 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | Germ, endosperm | 0.34 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | Hull (or husks) | 0.89 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Ogle) | Germ, endosperm, bran, hull | 0.34 mg/100g | (Xing & White, 1997) |
| | Oat (Ogle) | Hull | 5.42 mg/100g | (Xing & White, 1997) |
| | Oat | naked | 0.51 mg/100g | {Tong, 2014 #155} |
| | Oat (Wild oat, SH430, M73) | Germ, endosperm, bran, hull | 0.0007-0.0014 mg (per seed) | (Gallagher, <i>et al.</i> , 2010) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.37-4.75 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (unspecified) | hull | 593 mg/100g (fermented) | (Garleb, <i>et al.</i> , 1991) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 0.46-0.71 mg/100g | (Multari, <i>et al.</i> , 2018) |
| | Oat (commercial) | Bran | 1.01 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Oat (commercial), thermally processed | Bran | 1.25 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Oat (22 commercial varieties) | Seeds and bran | 0.49-1.29 mg/100 g | (Soycan, <i>et al.</i> , 2019) |
| | Oat (20 varieties) | Seeds | 0.81 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat (20 varieties) | Hull | 20.6 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Buckwheat | whole grain | 1.5 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | hull | 3.71 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Common Buckwheat | Hull | 0.03-0.05 mg/100g | (Kalinova, <i>et al.</i> , 2019) |
| | Buckwheat | seed | 0.21-1.6 mg/100g | {Guo, 2011 #156} |
| | Common and tartary buckwheat | | 221.1- 311.7 mg/100g | (Sytar, 2014) |
| syringic acid | Buckwheat | whole grain | 5.23 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | hull | 3.63 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | groat | 6.35 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Oat | bran | 2.8 mg/100g | (Mattila, <i>et al.</i> , 2005) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.46-0.79 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Mina DS) | Germ, endosperm | 0.34 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Mina DS) | Hull (or husks) | 0.68 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | Germ, endosperm | 0.55 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |

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| | Oat (Migla DS) | Hull (or husks) | 0.43 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 0.39-0.89 mg/100g | (Multari, <i>et al.</i> , 2018) |
| | Oat (22 commercial varieties) | Seeds and bran | 0.45-2.11 mg/100 g | (Soycan, <i>et al.</i> , 2019) |
| | Oat (20 varieties) | Seeds | 0.49 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat (20 varieties) | Hull | 3.88 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Tartary Buckwheat | Flower, leaf, root | 0.12-0.56mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Buckwheat | seed | 0.12-0.18mg/100g | {Guo, 2011 #156} |
| | Common Buckwheat | Seeds | 0.37 mg/ 100g | (Liu, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | Seeds | 0.19 mg/100g | (Liu, <i>et al.</i> , 2019) |
| syringaldehyde | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.32-2.12 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (unspecified) | hull | 566 mg/100g (fermented) | (Garleb, <i>et al.</i> , 1991) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 0.11-0.17 mg/100g | (Multari, <i>et al.</i> , 2018) |
| caffeic acid | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm | 0.52-1.57 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Ogle) | Germ, endosperm, bran, hull | 1.68 mg/100g | (Xing & White, 1997) |
| | Oat (Ogle) | Hull | - | (Xing & White, 1997) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.09-0.70 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (commercial) | Bran | 0.86 mg/100g | (Călinou & Vodnar, 2020) |
| | Oat (commercial), thermally processed | Bran | 2.28 mg/100g | (Călinou & Vodnar, 2020) |
| | Oat | grains | 0.2-23.9 nmol/g | (Skoglund, <i>et al.</i> , 2008) |
| | Oat (22 commercial varieties) | Seeds and bran | 1.04-7.27 mg/100 g | (Soycan, <i>et al.</i> , 2019) |
| | Oat (20 varieties) | Seeds | 0.86 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat (20 varieties) | Hull | 0.42 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Common Buckwheat | fiber | 1.12 mg/100g | (Wefers & Bunzel, 2015) |
| | Tartary Buckwheat | Flower, leaf, root | 0.29-1.84 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Buckwheat | seed | 0.12-0.49 mg/100g | {Guo, 2011 #156} |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | flour | 22-47 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | bran | 65-119 mg/100g | (Peng L., 2017) |
| | Common Buckwheat | Seeds | 9.11 mg/ 100g | (Park, <i>et al.</i> , 2019) |
| | Oat | bran | 0.5 mg/1006 | (Mattila, <i>et al.</i> , 2005) |
| | Common buckwheat | Seeds, sprouts | 8.8-15.1 umol/100g | (Alvarez-Jubete, <i>et al.</i> , 2010) |
| | Buckwheat | Hull, Groat | 0.04 mg/100g | (Dziedzic, <i>et al.</i> , 2009) |
| | Tartary Buckwheat | Flowers, leaves, stalk, roots | 0.29-1.84 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Common Buckwheat | Grains | 0.12-3.34 mg/100g | (Terpinc, <i>et al.</i> , 2016) |
| sinapic acid | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.91-1.03 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat | bran | 9 mg/1006 | (Mattila, <i>et al.</i> , 2005) |
| | Oat (Mina DS) | Germ, endosperm | 2.4 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Mina DS) | Hull (or husks) | 0.14 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | Germ, endosperm | 2.81 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Migla DS) | Hull (or husks) | 0.27 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat (Ogle) | Hull | 0.56 mg/100g | (Xing & White, 1997) |
| | Oat (commercial) | Bran | 0.47 mg/100g | (Călinou & Vodnar, 2020) |
| | Oat (commercial), thermally processed | Bran | 0.53 mg/100g | (Călinou & Vodnar, 2020) |
| | Oat (22 commercial varieties) | Seeds and bran | 1.89-8.03 mg/100 g | (Soycan, <i>et al.</i> , 2019) |
| | Buckwheat | Hull, Groat | 0.41 mg/100g | (Dziedzic, <i>et al.</i> , 2009) |
| | Buckwheat | whole grain | 2.81 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | hull | 2.98 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | groat | 3.04 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| ferulic acid | Common Buckwheat | fibre | 3.24 mg/100g | (Wefers & Bunzel, 2015) |
| | Common Buckwheat | Seeds | 0.35 mg/100g | (Liu, <i>et al.</i> , 2019) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.66-0.84 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Mina DS) | Germ, endosperm | 9.87 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) |
| | Oat | Grain | 16.50-149.36 mg/100g | (Kovacova & MaliNoVá, 2007) |

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|-----------------------|---|--|----------------------------|-----------------------------------|-------------------------|
| | Oat | naked | 0.23 mg/100g | {Tong, 2014 #155} | |
| | Oat (Mina DS) | Hull (or husks) | 30.9 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) | |
| | Oat | bran | 14 mg/1006 | (Mattila, <i>et al.</i> , 2005) | |
| | Oat | grain | 0.07-0.6 mg/100g | (Dokuyucu, <i>et al.</i> , 2003) | |
| | Oat (Migla DS) | Germ, endosperm | 10.5 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) | |
| | Oat (Migla DS) | Hull (or husks) | 45.85 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) | |
| | Oat (Ogle) | Germ, endosperm, bran, hull | 14.7 mg/100g | (Xing & White, 1997) | |
| | Oat (Ogle) | Hull | 14.2 mg/100g | (Xing & White, 1997) | |
| | Oat (Wild oat, SH430, M73) | Germ, endosperm, bran, hull | 0.09-0.13 mg (per seed) | (Gallagher, <i>et al.</i> , 2010) | |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.14-1.89 mg/100g | (Chen, <i>et al.</i> , 2018) | |
| | Oat (unspecified) | hull | 214 mg/100g (fermented) | (Garleb, <i>et al.</i> , 1991) | |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 53.2-82.9 mg/100g | (Multari, <i>et al.</i> , 2018) | |
| | Oat (commercial) | Bran | 0.46 mg/100g | (Călinou & Vodnar, 2020) | |
| | Oat (commercial), thermally processed | Bran | 0.49 mg/100g | (Călinou & Vodnar, 2020) | |
| | Oat (22 commercial varieties) | Seeds and bran | 15.2-115.3 mg/100g | (Soycan, <i>et al.</i> , 2019) | |
| | Oat (20 varieties) | Seeds | 32.7 mg/100g | (Varga, <i>et al.</i> , 2018) | |
| | Oat (20 varieties) | Hull | 809.5 mg/100g | (Varga, <i>et al.</i> , 2018) | |
| | Oat | bran | 33.0 mg/1006 | (Mattila, <i>et al.</i> , 2005) | |
| | Buckwheat | whole grain | 1.72 mg/100g | (Sedej, <i>et al.</i> , 2012) | |
| | Buckwheat | hull | 1.75 mg/100g | (Sedej, <i>et al.</i> , 2012) | |
| | Buckwheat | groat | 1.74 mg/100g | (Sedej, <i>et al.</i> , 2012) | |
| | Common and tartary buckwheat | | 5.6-7.3 mg/100g | (Sytar, 2014) | |
| | Common Buckwheat | fibre | 4.42 mg/100g | (Wefers & Bunzel, 2015) | |
| | Tartary Buckwheat | Flower, leaf, root | 0.32-1.18 mg/100g | (Dziedzic, <i>et al.</i> , 2018) | |
| | Common Buckwheat | Seeds | 0.89 mg/100g | (Liu, <i>et al.</i> , 2019) | |
| | Common Buckwheat | Grains | 0.17-42.8 µg/g | (Hung & Morita, 2008) | |
| | Buckwheat | seed | 1.86-7.29mg/100g | {Guo, 2011 #156} | |
| Cis-ferulic acid | Common Buckwheat | fibre | 0.93 mg/100g | (Wefers & Bunzel, 2015) | |
| Trans-ferulic acid | Common and tartary buckwheat | | 31.7-65.7mg/100g | (Sytar, 2014) | |
| p-anisic | Common and tartary buckwheat | | 744.5-1190 mg/100g | (Sytar, 2014) | |
| Methoxy-cinnamic acid | Common and tartary buckwheat | | 14.1-74.7 mg/100g | (Sytar, 2014) | |
| p -coumaric acid | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.24-1.19 mg/100g | (Shewry, <i>et al.</i> , 2008) | |
| | Oat | bran | 1.2 mg/1006 | (Mattila, <i>et al.</i> , 2005); | |
| | Oat | grain | 0.12-0.19 mg/100g | (Dokuyucu, <i>et al.</i> , 2003) | |
| | Oat (Mina DS) | Germ, endosperm | 0.57 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) | |
| | Oat (Mina DS) | Hull (or husks) | 26.9 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) | |
| | Oat (Migla DS) | Germ, endosperm | 1.13 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) | |
| | Oat (Migla DS) | Hull (or husks) | 39.9 mg/100g ^a | (Keriene, <i>et al.</i> , 2015) | |
| | Oat | grains | 0.3-29.7 nmol/g | (Skoglund, <i>et al.</i> , 2008) | |
| | Oat (Ogle) | Germ, endosperm, bran, hull | 4.49 mg/100g | (Xing & White, 1997) | |
| | Oat (Ogle) | Hull | 59.7 mg/100g | (Xing & White, 1997) | |
| | Oat (Wild oat, SH430, M73) | Germ, endosperm, bran, hull | 0.02-0.04 mg (per seed) | (Gallagher, <i>et al.</i> , 2010) | |
| | Oat (unspecified) | hull | 245 mg/100g (fermented) | (Garleb, <i>et al.</i> , 1991) | |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 59.0-82.6 mg/100g | (Multari, <i>et al.</i> , 2018) | |
| | Oat (commercial) | Bran | 0.26 mg/100g | (Călinou & Vodnar, 2020) | |
| | Oat (commercial), thermally processed | Bran | 0.30 mg/100g | (Călinou & Vodnar, 2020) | |
| | Oat (22 commercial varieties) | Seeds and bran | 0.19-4.94 mg/100 g | (Soycan, <i>et al.</i> , 2019) | |
| | Oat (20 varieties) | Seeds | 6.22 mg/100g | (Varga, <i>et al.</i> , 2018) | |
| | Oat (20 varieties) | Hull | 368 mg/100g | (Varga, <i>et al.</i> , 2018) | |
| Cis- p-coumaric acid | Common Buckwheat | fiber | 3.01 mg/100g | (Wefers & Bunzel, 2015) | |
| | Buckwheat | seed | 0.23-0.68mg/100g | {Guo, 2011 #156} | |
| | Tartary Buckwheat | Flower, leaf, root | 0.08-1.69 mg/100g | (Dziedzic, <i>et al.</i> , 2018) | |
| | Buckwheat | Hull, Groat | 0.07-0.29 mg/100g | (Dziedzic, <i>et al.</i> , 2009) | |
| | Coumaric | Common Buckwheat | fibre | 0.589 mg/100g | (Wefers & Bunzel, 2015) |
| | coumaric | Oat | grain | 8.05-210.27 mg/100 g | (Kovacova & Malinová, |

| | | | | (2007) |
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| Ferulic acid | Oat | grains | 0.4-15.4 nmol/l | (Skoglund, <i>et al.</i> , 2008) |
| o-coumaric acid | Oat (Ogle) | Hull | 0.69 mg/100g | (Xing & White, 1997) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 0.11-0.38 mg/100g | (Multari, <i>et al.</i> , 2018) |
| 2-hydroxycinnamic acid | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.05-0.67 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| 2,4-dihydrobenzoic acid (Protocatechuic acid) | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.10-1.04 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Buckwheat | whole grain | 9.26 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | hull | 16.8 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | groat | 10.3 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat | seed | 1.71-4.63mg/100g | {Guo, 2011 #156} |
| | Common Buckwheat | Hull | 0.18-0.21 mg/100g | (Kalinova, <i>et al.</i> , 2019) |
| | Common Buckwheat | Seeds | 0.4 mg/100g | (Liu, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | Seeds | 1.0 mg/100g | (Liu, <i>et al.</i> , 2019) |
| | Oat (Cacko) | Germ, endosperm, bran, hull | 0.50 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (commercial) | Bran | 5.50 mg/100g | (Călinoiu & Vodnar, 2020) |
| Vitexin | Oat (commercial), thermally processed | Bran | 7.62 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Tartary Buckwheat (Kitawase, Hokkai T8,T9,T10) | Sprouts | 45-645 mg/100g | (Arasu, <i>et al.</i> , 2014) |
| | Tartary Buckwheat | Flowers, leaves, stalk, root | 0.33-4.22 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Common Buckwheat | Hull | 0.69-1.2 mg/100g | (Kalinova, <i>et al.</i> , 2019) |
| | Common Buckwheat/Tartary Buckwheat (Kitawase, Hokkai T9) | Seeds, Sprouts | 20-630 mg/100g | (Kim, <i>et al.</i> , 2008) |
| | Common Buckwheat | Seeds | 0.25-3.28 mg/100g | (Kiprovski, <i>et al.</i> , 2015) |
| | Tartary Buckwheat | flour | 1-3 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat | bran | 4-9 mg/100g | (Peng L., 2017) |
| | Common Buckwheat | Sprouts | 463 mg/100g | (Chen, <i>et al.</i> , 2020) |
| | Common Buckwheat | Sprouts, microgreens, leafy greens | 581.27 mg/100g | (Sharma, 2011) |
| isovitexin | Common Buckwheat | Sprouts, microgreens, leafy greens | 370.14 mg/100g | (Sharma, 2011) |
| Avenanthramides | | | | |
| Compound | Plant (Cultivar) | Plant parts | Concentration | Author |
| Total avenanthramides (AVAs) | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 4.20-9.10 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.50-21.43 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 1.12-8.39 mg/100g | (Multari, <i>et al.</i> , 2018) |
| | Oat (commercial) | Bran | 0.79-13.3 mg/100g | (Hu, <i>et al.</i> , 2019) |
| | Oat | naked | 3.73- 71.85mg/100g | {Tong, 2014 #155} |
| AVA 2c | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 1.58-4.49 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Matilda, Sang, Freja) | Germ, endosperm, bran, hull | 74-115 nmol/g | (Dimberg, <i>et al.</i> , 2005) |
| | Oat (Gem, Vista) | Leaves, spikelet, germ, endosperm, bran, hull | 4.02-7.8 nmol/g | (D. M. Peterson & Dimberg, 2008) |
| | Oat (10 commercial brands) | Germ, endosperm, bran, hull | 1.1-1.6 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (10 commercial brands) | Bran | 0.9-2.9 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (10 commercial brands), rolled oats | Germ, endosperm, bran, hull | 0.7-2.1 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.16-7.00 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 0.35-3.92 mg/100g | (Multari, <i>et al.</i> , 2018) |
| | Oat (commercial) | Bran | 0.41 mg/100g | (Călinoiu & Vodnar, 2020) |

| | | | | |
|--------|-----|-------|--------------|-------------------|
| | Oat | naked | 1.85 mg/100g | {Tong, 2014 #155} |
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|--------|--|--|--------------------------------|---------------------------------------|
| AVA 2p | Oat (commercial), thermally processed | Bran | 0.63 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Oat (commercial) | Bran | 0.07-1.49 mg/100g | (Hu, <i>et al.</i> , 2019) |
| | Oat (20 varieties) | Seeds | 0.66 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat (20 varieties) | Hull | 6.37 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat | Hulls, groats | 0.11 mg/100g | (Ortiz-Robledo, <i>et al.</i> , 2013) |
| | Oat | Flakes, whole grain | 0.4-0.9 mg/1006 | (Mattila, <i>et al.</i> , 2005); |
| | Oat | grain | 0.6-2.9 mg/100g | (Dokuyucu, <i>et al.</i> , 2003) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 1.3-3.0 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Matilda, Sang, Freja) | Germ, endosperm, bran, hull | 78-120 nmol/g | (Dimberg, <i>et al.</i> , 2005) |
| | Oat (Gem, Vista) | Leaves, spikelet, germ, endosperm, bran, hull | 3.93-74.26 nmol/g | (D. M. Peterson & Dimberg, 2008) |
| | Oat (10 commercial brands) | Germ, endosperm, bran, hull | 0.6-1.5 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (10 commercial brands) | Bran | 0.7-1.6 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (10 commercial brands), rolled oats | Germ, endosperm, bran, hull | 0.6-1.9 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.23-7.45 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 0.60-3.96 mg/100g | (Multari, <i>et al.</i> , 2018) |
| AVA 2f | Oat | Hulls, groats | 0.15 mg/100g | (Ortiz-Robledo, <i>et al.</i> , 2013) |
| | Oat (commercial) | Bran | 0.70 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Oat (commercial), thermally processed | Bran | 0.87 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Oat (commercial) | Bran | 0.06-3.32 mg/100g | (Hu, <i>et al.</i> , 2019) |
| | Oat | Flakes, whole grain | 0.4-0.9 mg/1006 | (Mattila, <i>et al.</i> , 2005); |
| | Oat | grain | 0.3-1.9 mg/100g | (Dokuyucu, <i>et al.</i> , 2003) |
| | Oat (20 varieties) | Seeds | 2.56 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat (20 varieties) | Hull | 2.48 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat | Hulls, groats | 0.12 mg/100g | (Ortiz-Robledo, <i>et al.</i> , 2013) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 1.27-2.40 mg/100g ^a | (Sterna, <i>et al.</i> , 2014) |
| | Oat (Matilda, Sang, Freja) | Germ, endosperm, bran, hull | 62-65 nmol/g | (Dimberg, <i>et al.</i> , 2005) |
| | Oat (Gem, Vista) | Leaves, spikelet, germ, endosperm, bran, hull | 3.35-18.16 nmol/g | (D. M. Peterson & Dimberg, 2008) |
| | Oat (10 commercial brands) | Germ, endosperm, bran, hull | 0.9-2.3 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (10 commercial brands) | Bran | 1.0-2.8 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (10 commercial brands), rolled oats | Germ, endosperm, bran, hull | 0.6-2.2 mg/100g | (Pridal, <i>et al.</i> , 2018) |
| | Oat (13 cultivars) | Germ, endosperm, bran, hull | 0.11-6.97 mg/100g | (Chen, <i>et al.</i> , 2018) |
| | Oat (8 cultivars) | Germ, endosperm, bran, hull | 0.47-2.19 mg/100g | (Multari, <i>et al.</i> , 2018) |
| | Oat (commercial) | Bran | 0.78 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Oat (commercial), thermally processed | Bran | 0.91 mg/100g | (Călinoiu & Vodnar, 2020) |
| | Oat (commercial) | Bran | 0.05-6.62 mg/100g | (Hu, <i>et al.</i> , 2019) |
| | Oat | Flakes, whole grain | 0.4-0.9 mg/1006 | (Mattila, <i>et al.</i> , 2005) |
| | Oat | grain | 0.3-2.8 mg/100g | (Dokuyucu, <i>et al.</i> , 2003) |
| | Oat (20 varieties) | Seeds | 2.18 mg/100g | (Varga, <i>et al.</i> , 2018) |
| | Oat (20 varieties) | Hull | 3.03 mg/100g | (Varga, <i>et al.</i> , 2018) |

| Compound | Plant | Plant part | Concentration | Author |
|--------------|---|--|----------------------------------|------------------------------------|
| Total tocols | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 1.61-3.61 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (12 cultivars) ^b | Germ, endosperm, bran | 1.9 to 3.0 mg /100g ^c | (D.M. Peterson & Qureshi, 1993) |
| | Oat (unspecified) ^d | Germ, endospore, bran | 7.21 mg/100g | (Panfilii, <i>et al.</i> , 2003) |
| | Oat (Slawko) | Germ, endospore, bran | 0.5 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Buckwheat Kora | whole grain | 5.46 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Buckwheat Kora, | endosperm with embryo | 6.44 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Buckwheat Mancan variety | seed | 55.22mg/100g | (Przybylski, <i>et al.</i> , 1998) |
| Trienols | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 1.09-2.57 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Slawko) | Germ, endospore | 1.35 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| α -T | Buckwheat | whole grain, hull, groat | 3.32-9.44 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat Kora | whole grain | 0.09 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Buckwheat Kora | endosperm with embryo | 0.19 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Buckwheat Mancan variety | seed | 38.01 mg/100g | (Przybylski, <i>et al.</i> , 1998) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.45-0.98 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (12 cultivars) ^b | Germ, endosperm, bran | 0.72 – 0.94 mg/100g ^c | (D.M. Peterson & Qureshi, 1993) |
| | Oat (unspecified) ^d | Germ, endospore, bran | 1.49 mg/100g | (Panfilii, <i>et al.</i> , 2003) |
| | Oat (Slawko) | Germ, endospore | 0.09 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 0.56-4.14 mg/100g | (Musa Ozcan, <i>et al.</i> , 2006) |
| α -T3 | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.94-2.30 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (12 cultivars) ^b | Germ, endosperm, bran | 0.09- 0.19 mg/100g ^c | (D.M. Peterson & Qureshi, 1993) |
| | Oat (unspecified) ^d | Germ, endospore, bran | 5.64 mg/100g | (Panfilii, <i>et al.</i> , 2003) |
| | Oat (Slawko) | Germ, endospore | 0.27 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| β -T | Buckwheat Mancan variety | seed | 1.65 mg/100g | (Przybylski, <i>et al.</i> , 1998) |
| | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.06-0.10 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (12 cultivars) ^b | Germ, endosperm, bran | 0.07-0.13 mg/100g ^c | (D.M. Peterson & Qureshi, 1993) |
| | Oat (unspecified) ^d | Germ, endospore, bran | 0.3 mg/100g | (Panfilii, <i>et al.</i> , 2003) |
| | Oat (Slawko) | Germ, endospore | 0.08 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 0.08-0.84 mg/100g | (Musa Ozcan, <i>et al.</i> , 2006) |
| β -T3 | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.13-0.27 mg/100g | (Shewry, <i>et al.</i> , 2008) |
| | Oat (12 cultivars) ^b | Germ, endosperm, bran | 0.05- 0.15 mg/100g ^c | (D.M. Peterson & Qureshi, 1993) |
| | Oat (unspecified) ^d | Germ, endospore, bran | 0.54 mg/ 100g | (Panfilii, <i>et al.</i> , 2003) |
| | Oat (Slawko) | Germ, endospore | 0.11 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| γ -T | Buckwheat | whole grain, hull, groat | 10.1-22.10 mg/100g | (Sedej, <i>et al.</i> , 2012) |
| | Buckwheat Kora | whole grain | 5.14 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Buckwheat Kora | endosperm with embryo | 6.04 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| | Buckwheat Mancan variety | seed | 10.56 mg/100g | (Przybylski, <i>et al.</i> , 1998) |
| | Oat (12 cultivars) ^b | Germ, endosperm, bran | 0.05-0.12 mg/100g ^c | (D.M. Peterson & Qureshi, 1993) |
| | Oat (unspecified) ^d | Germ, endospore, bran | 0.04 mg/100g | (Panfilii, <i>et al.</i> , 2003) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 0.03-0.36 mg/100g | (Musa Ozcan, <i>et al.</i> , 2006) |
| | Buckwheat Kora | whole grain | 0.24 mg/100g | (Zielinski, <i>et al.</i> , 2001) |
| δ -T | Buckwheat | endosperm with embryo | 0.22 mg/100g | (Zielinski, <i>et al.</i> , 2001) |

| | | | |
|---|-----------------------------|--------------------------|--|
| | Kora | | |
| | Buckwheat Mancan variety | seed, | 3.64 mg/100g (Przybylski, <i>et al.</i> , 1998) |
| | Buckwheat | whole grain, hull, groat | 0.37-0.46 mg/100g (Sedej, <i>et al.</i> , 2012) |
| ^e Expressed originally as micrograms per gram, converted to milligram per 100g | | | |

| Supplemental table 3. Phytosterols, polysaccharides and fatty acids in oat and buckwheat | | | | |
|--|---|--|--------------------------------|----------------------------------|
| Phytosterols | | | | |
| Compound | Plant (cultivar) | Plant part | Concentration | Author |
| Total sterols | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 61.8-68.2 mg/100g ^a | (Horbowicz & Obendorf, 1992) |
| | Oat (Elin, Freja, Galopp, Matilda, Strok, Stormogul, Vital) | Germ, endosperm, bran, hull | 35-49.1 mg/100g | {Maatta, 1999 #83} |
| | Common Buckwheat | Hulls, Groat | 19-139 mg/100g | (Dziedzic, <i>et al.</i> , 2018) |
| | Buckwheat | Flour | 99 mg/100g | {Bacchetti, 2011 #189} |
| Stanols, % | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 1.3-1.6 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| stanols | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 1.3-1.6 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| sitosterol | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 36.5-44.2mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Vatter) | Leaves | 42.6% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | 42.9% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ and endosperm | 30.6% ^b | (Eichenberger, 1984) |
| | Oat (Elin, Freja, Galopp, Matilda, Strok, Stormogul, Vital) | Germ, endosperm, bran, hull | 23.7-32.1 mg/100g | {Maatta, 1999 #83} |
| campesterol | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 5.0-6.2 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Vatter) | Leaves | Trace | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | Trace | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | trace | (Eichenberger, 1984) |
| | Oat (Vatter) | Leaves | Trace | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | Trace | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | trace | (Eichenberger, 1984) |
| | Oat (Elin, Freja, Galopp, Matilda, Strok, Stormogul, Vital) | Germ, endosperm, bran, hull | 3.2-4.6 mg/100g | {Maatta, 1999 #83} |
| stigmasterol | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 2.2-3.6 mg/100g ^a | (Peng L., 2017) |
| | Oat (Vatter) | Leaves | 28.4% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | 3.9% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | 4.6% ^b | (Eichenberger, 1984) |
| | Oat (Elin, Freja, Galopp, Matilda, Strok, Stormogul, Vital) | Germ, endosperm, bran, hull | 1.1-2.1 mg/100g | {Maatta, 1999 #83} |
| Δ^7 -stigmasterol | Oat (Vatter) | Leaves | 1.7% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | 1.0% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | 2.0% ^b | (Eichenberger, 1984) |
| stigmastanol | Oat (Vatter) | Leaves | 0.8% | (Eichenberger, 1984) |
| lophenol | Oat (Vatter) | Leaves | 1.8% | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | --- | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | 0.6% | (Eichenberger, 1984) |
| Δ^5 -avenasterol | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 2.4- 3.4 mg/100g ^a | |
| | Oat (Vatter) | Leaves | 2.4% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | 26.1% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | 23.2% ^b | (Eichenberger, 1984) |
| | Oat (Elin, Freja, Galopp, Matilda, Strok, Stormogul, Vital) | Germ, endosperm, bran, hull | 1.5-4.7 mg/100g | {Maatta, 1999 #83} |
| Δ^7 -avenastenol | Oat (Cacko, MV-Pehely, Fengli, Expander, Bajka) | Germ, endosperm, bran, hull (except for naked Cacko) | 0.8- 1.2 mg/100g ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Vatter) | Leaves | 1.7% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | 0.6% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | 9.0% ^b | (Eichenberger, 1984) |
| cholestanol | Oat (Vatter) | Leaves | 2.9% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | Trace | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | 0.4% ^b | (Eichenberger, 1984) |
| Δ^7 -cholestolenol | Oat (Vatter) | Leaves | 1.7% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | 0.6% ^b | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, endosperm | 0.9% ^b | (Eichenberger, 1984) |

*Cacko is a naked oat variety with high protein content. It has a high soluble dietary fibre (including β -glucan) content, but it is also sensitive to the environment and may give lower yields than other cultivars. Bajka is an intensive type with good protein content and seed yield. Expander is also an intensive type with good yield and is less sensitive to environmental effects. MV-Pehely has high protein content, whereas Fengli is a tall type.

**total phenolics as gallic acid equivalents

*** Total phenol (gallic acid equivalent) and flavonoid (quercetin equivalent) contents were determined using Folin–Ciocalteau and aluminum chloride reagents, respectively

**** catechin equivalents

^aOriginal units converted from microgram/gram to milligram/100g ((A.R. Gulpinar, et al., 2011))

^bExpressed in percent (%) of the total sterol extracted

| Polysaccharides | | | | |
|------------------------|-----------|---|---------------------------|--|
| Compound | Plant | Species/ cultivars | Concentration | Author |
| Total fagopyritols | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 128.2-962.1mg/100g | (Steadman, et al., 2001) |
| fagopyritol A1 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 12.4-235.8 mg/100g | (Steadman, et al., 2001) |
| fagopyritol A2 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 9.2-101.5mg/100g | (Steadman, et al., 2001) |
| fagopyritol A3 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 11.1-65.8 mg/100g | (Steadman, et al., 2001) |
| fagopyritol B1 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 78.9-1510.7 mg/100g | (Steadman, et al., 2001) |
| fagopyritol B2 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 16.7-84.5 mg/100g | (Steadman, et al., 2001) |
| fagopyritol B3 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | trace | (Steadman, et al., 2001) |
| Fagopyritols | Buckwheat | bran | 2600mg/100g | (Brindzova, et al., 2008) |
| Total fagopyritols | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 176.4-2774.5 mg/100g | (Steadman, et al., 2001) |
| fagopyritol A1 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 18.8-327.5mg/100g | (Steadman, et al., 2001) |
| fagopyritol A2 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 14.2-188.8mg/100g | (Steadman, et al., 2001) |
| fagopyritol A3 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 11.2-92.3mg/100g | (Steadman, et al., 2001) |
| fagopyritol B1 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 115.7mg/100g-2004 mg/100g | (Steadman, et al., 2001) |
| fagopyritol B2 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 16.5-216mg/100g | (Steadman, et al., 2001) |
| fagopyritol B3 | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | trace | (Steadman, et al., 2001) |
| D-chiro-inositol | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 15.4-161.7mg/100g | (Steadman, et al., 2001) |
| D-chiro-inositol | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 6.9-82.1mg/100g | (Steadman, et al., 2001) |
| amylopectin | Buckwheat | Starch | 75000 mg/100g | (Qin, et al., 2010; Takahama & S., 2010) |
| myo-inositol | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 8.4-88.1mh/100g | (Steadman, et al., 2001) |
| myo-inositol | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 3.3-40.5 mg/100g | (Steadman, et al., 2001) |
| galactinol | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 5.2-70.4mg/g | (Steadman, et al., 2001) |
| galactinol | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 3.5-36.5mg/100g | (Steadman, et al., 2001) |
| sucrose | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 392.6-2463.5mg/100g | (Steadman, et al., 2001) |
| sucrose | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 223-3876.3mg/100g | (Steadman, et al., 2001) |
| α -galactosides | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Groats | 37-44% | (Steadman, et al., 2001) |
| α -galactosides | Buckwheat | Buckwheat (Cv. Manor) Milling Fractions from Whole Achenesa | 38-42% | (Steadman, et al., 2001) |
| amylase | Buckwheat | starch | 25000 mg/100g | (Qin, et al., 2010; Takahama & S., 2010) |
| Phytic acid | Buckwheat | bran | 3500- | (Sterna, et al., 2014); |

| | | | | |
|-------------------|---|--------------------------------|-------------------------|--|
| | | | 3800mg/100 g | |
| Glucan | Oat (unspecified) ^b | Germ, endosperm, bran | 6.3g/60g of starch | (Regand, <i>et al.</i> , 2011) |
| Beta glucan | Oat | | 3.9% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat | flour | 0.5-5.6% | (Van den Broeck, <i>et al.</i> , 2015) |
| | Oat (Cacko) | Germ, endosperm | 1.09% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (MV-Pehely) | Germ, endosperm | 1.12% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Fengli) | Germ, endosperm | 1.03% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Expander) | Germ, endosperm | 1.03% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Bajka) | Germ, endosperm | 0.96% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Cacko) | Bran | 8.33% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (MV-Pehely) | Bran | 8.09% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Fengli) | Bran | 6.20% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Expander) | Bran | 8.18% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Bajka) | Bran | 8.39% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Cacko) | Germ, endosperm, bran | 5.5% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (MV-Pehely) | Germ, endosperm, bran | 5.6% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Fengli) | Germ, endosperm, bran | 4.5% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Expander) | Germ, endosperm, bran | 5.1% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Bajka) | Germ, endosperm, bran | 5.3% ^a | (Shewry, <i>et al.</i> , 2008) |
| | Oat (Cyril) | Germ, endosperm, bran | 28 200 mg/100 g | (Hozova, <i>et al.</i> , 2007) |
| | Oat (Jakub) | Germ, endosperm, bran | 5 180 mg/100 g | (Hozova, <i>et al.</i> , 2007) |
| Fatty acids | Oat (unspecified) | Groat | 4.1-5.7% | (Sowa & White, 1992) |
| | Buckwheat Fagopyrum | Whole grain | 1 260 mg/100g | (Hozova, <i>et al.</i> , 2007) |
| Total fatty acids | | | | |
| Total fatty acids | Buckwheat | bran | 11000mg/100 g | (Steadman, <i>et al.</i> , 2001) |
| | Buckwheat | embryo | 8.2% ^a | (Dorrell, 1971) |
| | Buckwheat | endosperm | 0.4% ^a | (Dorrell, 1971) |
| | Buckwheat | testa | 2.0% ^a | (Dorrell, 1971) |
| | Buckwheat | pericarp | 0.5% ^a | (Dorrell, 1971) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 288-5429mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 294-6264 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| C14:0 | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 11-12.4 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 23-23.4 mg/100g | (Peng L., 2017) |
| | Common Buckwheat | Embryo, Endosperm | 0.3-14.9% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 14-157 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 14-81mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Common Buckwheat | grains | 530-800mg/100g | (Golijan, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | whole seed | 0.1-0.5% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | embryo | 10.8-17.4% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | endosperm | 14.9-20% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | testa | 10.4-18.2% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | pericarp | 11% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 184.2-238.9 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 380.6-423.8 mg/100g | (Peng L., 2017) |
| | Common Buckwheat | Embryo, Endosperm | 13.1-70.5% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 17.1-18.6% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 1473-2642 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 1386-2434 | (Sinkovic, <i>et al.</i> , 2020) |

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| | | | mg/100g | |
| | Common Buckwheat | grains | 18600-2401 mg/100g | (Golijan, <i>et al.</i> , 2019) |
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| C18:0 | Common Buckwheat | grains | 4400-5090 mg/100g | (Golijan, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | whole seed | 2-2.4% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | embryo | 1.6-2.2% ^a | (Dorrell, 1971) |
| | Tartary, Buckwheat | endosperm | 2.2-3.7% ^a | (Dorrell, 1971) |
| | Tartary, Buckwheat | testa | 2.2.-2.8% ^a | (Dorrell, 1971) |
| | Tartary, Buckwheat | pericarp | 2.5-5% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 67.4-100.4 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 105.4-125.4 mg/100g | (Peng L., 2017) |
| | Common Buckwheat | Embryo, Endosperm | 2.6-5.3% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat/ Tartary Buckwheat | Seed | 1.89-2.05% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 167-336 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 193-499 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | whole seed | 32.5-38.5% ^a | (Dorrell, 1971) |
| | Common Buckwheat | grains | 52020-53420 mg/100g | (Golijan, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | embryo | 33.2-40.5% ^a | (Dorrell, 1971) |
| | Tartary,Buckwheat | endosperm | 31-35.5% ^a | (Dorrell, 1971) |
| | Tartary,Buckwheat | testa | 28.7-33.9% ^a | (Dorrell, 1971) |
| | Tartary, Buckwheat | pericarp | 14.6-19.6% ^a | (Dorrell, 1971) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 35.9-36.7% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Common Buckwheat | Embryo, Endosperm | 6.1-33.7% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 2096- 3647mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 2620-4076 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| C18:1 | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 264.7-283.9 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 547.2-722.2 mg/100g | (Peng L., 2017) |
| | Common Buckwheat | grains | 32740-53420 mg/100g | (Golijan, <i>et al.</i> , 2019) |
| C18:2 | Common Buckwheat | grains | 9330- 12040mg/100 g | (Golijan, <i>et al.</i> , 2019) |
| | Common Buckwheat | Embryo,Endosperm | 1.9-49.6% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 34.4-36.9% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Tartary, Buckwheat | whole seed | 30.9-34.7% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | embryo | 32.4-36.8% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | endosperm | 16.8-33% ^a | (Dorrell, 1971) |

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| | Tartary Buckwheat | , testa | 27.6-32.7% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , pericarp | 13-25.7% ^a | (Dorrell, 1971) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 3723-4757 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 3554-4490mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| C18:2n-6c | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 258.3-329.9 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 793-1032.4 mg/100g | (Peng L., 2017) |
| C18:3n-3 | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 21.9-26.1mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 38.4-49.4mg/100g | (Peng L., 2017) |
| C18:3 | Common Buckwheat | grains | 5340-6740 mg/100g | (Golijan, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | , whole seed | 3.2-6-2% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , embryo | 2.4-6.5% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , endosperm | 2.6-5.7% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , testa | 4.4-6-4% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , pericarp | 2.9-4.2% ^a | (Dorrell, 1971) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 1.56-2.24% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Common Buckwheat | Embryo, Endosperm | 1.1-12.9% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 221-578 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 168-360mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| C20:0 | Common Buckwheat | grains | 2720-3380 mg/100g | (Golijan, <i>et al.</i> , 2019) |
| | Tartary Buckwheat | whole seed | 1.5-2.2% ^a | (Dorrell, 1971; A.R. Gulpinar, <i>et al.</i> , 2011) |
| | Tartary Buckwheat | embryo | 1.1-1.6% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | endosperm | 1.1-3-1% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | testa | 1-3.3% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | pericarp | 3.3-5-3% ^a | (Dorrell, 1971) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 1.13-1.40% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Common Buckwheat | Embryo, Endosperm | 1.1-2.4% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat | Whole seed, hulls, bran, flour | 184-304 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat | Whole seed, hulls, bran, flour | 113-203 mg/100g | (Sinkovic, <i>et al.</i> , 2020) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 15.2-16.5 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 34.4-35.6 mg/100g | (Peng L., 2017) |
| | Common Buckwheat | grains | 0190-360 mg/100g | (Golijan, <i>et al.</i> , 2019) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Flour | 8.8-12.1 mg/100g | (Peng L., 2017) |
| | Tartary Buckwheat Chuanqiao 1&2, Xiqiao 3 | Bran | 26.0-31.8 mg/100g | (Peng L., 2017) |

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| | Common Buckwheat | Embryo, Endosperm | 1.1-3.6% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 2.12-2.95% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| C22:1 | Tartary Buckwheat | Seed | 0.500 mg/100g | Tsuzuki, <i>et al.</i> , 1991) |
| C22:0 | Tartary Buckwheat | , whole seed | 1.1-2.2% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , embryo | 0.8-1.7% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , endosperm | 0.9-2.4% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , testa | 1.2-4% ^a | (Dorrell, 1971) |
| | Tartary Buckwheat | , pericarp | 0.1-6.2% ^a | (Dorrell, 1971) |
| | Common Buckwheat | Embryo, Endosperm | 0.9-2.8% ^a | (Horbowicz & Obendorf, 1992) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 1.06-1.44% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Common Buckwheat | grains | 250 mg/100g | (Golijan, <i>et al.</i> , 2019) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 0.18-0.52% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| | Common Buckwheat/Tartary Buckwheat | Seed | 0.60-0.91% ^a | (Tsuzuki, <i>et al.</i> , 1991) |
| 1,2 diacylglycerol | Oat (33 wild species) | Germ, endosperm, bran | 1.5, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat (10 cultivated species) | Germ, endosperm, bran | 1.1, % ^b | (Leonova, <i>et al.</i> , 2008) |
| 1,3 diacylglycerol | Oat (33 wild species) | Germ, endosperm, bran | 2.2, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat (10 cultivated species) | Germ, endosperm, bran | 2.3, % ^b | (Leonova, <i>et al.</i> , 2008) |
| Free fatty acid | Oat (33 wild species) | Germ, endosperm, bran | 1.6, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat (10 cultivated species) | Germ, endosperm, bran | 2.4, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat | Groat, bran, endosperm, scutellum, embrioni | 2-5% | (Youngs, 1978) |
| TAG1 | Oat (wild species) | Germ, endosperm, bran | 1.2, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat (cultivated species) | Germ, endosperm, bran | 1.4, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Common buckwheat | grain | 9.94-29.69 % | (Golijan, <i>et al.</i> , 2019) |
| TAG2 | Oat (wild species) | Germ, endosperm, bran | 0.9, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat (cultivated species) | Germ, endosperm, bran | 1.1, % ^b | (Leonova, <i>et al.</i> , 2008) |
| Total Triacylglycerol | Oat (wild species) | Germ, endosperm, bran | 77.1, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat (cultivated species) | Germ, endosperm, bran | 74.2, % ^b | (Leonova, <i>et al.</i> , 2008) |
| | Oat (15 cultivars) | Groat, bran, endosperm, scutellum, embrioni | 39-58% | (Youngs, 1978) |
| Myristic (C14:0) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.5-0.7% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat (Laima, Arta, St.Līva, St.Dārta) | Germ, endosperm, bran, hull | 0.2% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (15 cultivars) | Groat, bran, endosperm, scutellum, embrioni | 0.4-0.8% | |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 0.2-0.3% | (Brindzova, <i>et al.</i> , 2008) |
| Palmitic (C16:0) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 21.4-22.8% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat | flour | 31.8- 262.3 mg/100g | (Van den Broeck, <i>et al.</i> , 2015) |
| | Common Buckwheat | Seeds | 13.5% | (A. R. Gulpinar, <i>et al.</i> , 2012) |

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| | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 16.1-17.1% | (Stern, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 15.5-17.4% | (Stern, <i>et al.</i> , 2014) |
| | Oat (15 cultivars) | Groat, bran, endosperm, scutellum, embrioni | 16.1-21.8% | (Youngs, 1978) |
| | Oat (Astor, Maldwyn, C 5020, C5027, C5031, Nuprime) | Germ, endosperm, bran, +/-hull | 16.6-21.7% | (Welch, 1975) |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 13.8-17.2% | (Brindzova, <i>et al.</i> , 2008) |
| | Oat (Freja, Matilda) | Germ, endosperm, bran, hull | 12.0-16.1% | (Banas, <i>et al.</i> , 2007) |
| | Oat (Freja, Matilda) | Emrbyo and scutellum | 14.0-20.9% | (Banas, <i>et al.</i> , 2007) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 15.7-18.8% | (Musa Ozcan, <i>et al.</i> , 2006) |
| Palmitoleic (C16:1 cis-9) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.2-0.3% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 0.2-0.3% | (Brindzova, <i>et al.</i> , 2008) |
| Stearic (C18:0) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 1.5-3-1% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 1.7-2.5% | (Stern, <i>et al.</i> , 2014) |
| | Oat | flour | 7.6-33.3 mg/100g | (Van den Broeck, <i>et al.</i> , 2015) |
| | Common Buckwheat | Seeds | 1.62% | (A. R. Gulpinar, <i>et al.</i> , 2012) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 1.7-2.4% | (Stern, <i>et al.</i> , 2014) |
| | Oat (15 cultivars) | Groat, bran, endosperm, scutellum, embrioni | 1.2-2% | (Youngs, 1978) |
| | Oat (Astor, Maldwyn, C 5020, C5027, C5031, Nuprime) | Germ, endosperm, bran, +/-hull | 1.05-2.18% | (Welch, 1975) |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 1.3-2.2% | (Brindzova, <i>et al.</i> , 2008) |
| | Oat (Freja, Matilda) | Germ, endosperm, bran, hull | 0.5-2.6% | (Banas, <i>et al.</i> , 2007) |
| | Oat (Freja, Matilda) | Emrbyo and scutellum | 0.4-0.9% | (Banas, <i>et al.</i> , 2007) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 2.79% | (Musa Ozcan, <i>et al.</i> , 2006) |
| Oleic (C18:1) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 36.2-37.8% | (Stern, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 37.9-40.4% | (Stern, <i>et al.</i> , 2014) |
| | Oat (Freja, Matilda) | Germ, endosperm, bran, hull | 17.3-51.6% | (Banas, <i>et al.</i> , 2007) |
| | Oat (Freja, Matilda) | Emrbyo and scutellum | 30.5-43.0% | (Banas, <i>et al.</i> , 2007) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 33.97-51.26% | (Musa Ozcan, <i>et al.</i> , 2006) |
| | Common Buckwheat | Seeds | 33.15% | (A. R. Gulpinar, <i>et al.</i> , 2012) |
| Elaidic (C18:1trans-9) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.1-0.5% | (Kourimska, <i>et al.</i> , 2018) |
| Oleic (C18:1 cis-9) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 30.7-32.2% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat (15 cultivars) | Groat, bran, endosperm, scutellum, embrioni | 28.4-40.3% | (Youngs, 1978) |

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| | Oat (Astor, Maldwyn, C 5020, C5027, C5031, Nuprime) | Germ, endosperm, bran, +/-hull | 22.0-32.5% | (Welch, 1975) |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 33.4-42.2% | (Brindzova, <i>et al.</i> , 2008) |
| | Oat | flour | 113.7-723.3 mg/100g | (Van den Broeck, <i>et al.</i> , 2015) |
| Cis-13-Octadecenoic (C18:1 cis-13) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 1.5-1.8% | (Kourimska, <i>et al.</i> , 2018) |
| Linoleic (C18:2) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 1-1.2% | (Sterna, <i>et al.</i> , 2014) |
| | Oat | flour | 1.2-17.1 mg/100g | (Van den Broeck, <i>et al.</i> , 2015) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 0.9-1.2% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (Astor, Maldwyn, C 5020, C5027, C5031, Nuprime) | Germ, endosperm, bran, +/-hull | 44.4-50.3% | (Welch, 1975) |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 34.4-42.7% | (Brindzova, <i>et al.</i> , 2008) |
| | Oat (Freja, Matilda) | Germ, endosperm, bran, hull | 29.9-47.0% | (Banas, <i>et al.</i> , 2007) |
| | Oat (Freja, Matilda) | Emrbyo and scutellum | 34.6-45.6% | (Banas, <i>et al.</i> , 2007) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 22.8-35.9% | (Musa Ozcan, <i>et al.</i> , 2006) |
| | Common Buckwheat | Seeds | 31.93% | (A. R. Gulpinar, <i>et al.</i> , 2012) |
| C18:2 (n-6) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 39.4-41.6% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 38.4-39.1% | (Sterna, <i>et al.</i> , 2014) |
| Linoelaidic trans (C18:2 trans,trans-9,12) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | <0.1-0.4% | (Kourimska, <i>et al.</i> , 2018) |
| Linoelaidic cis (C18:2 cis,cis-9,12) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 34.6-38.2% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat (15 cultivars) | Groat, bran, endosperm, scutellum, embrioni | 36.6-45.8% | (Youngs, 1978) |
| Linolenic (C18:3) | Oat (15 cultivars) | Groat, bran, endosperm, scutellum, embrioni | 1.5-2.5% | (Youngs, 1978) |
| | Oat (Astor, Maldwyn, C 5020, C5027, C5031, Nuprime) | Germ, endosperm, bran, +/-hull | 1.89-3.38% | (Welch, 1975) |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 1.1-1.9% | (Brindzova, <i>et al.</i> , 2008) |
| | Oat (Freja, Matilda) | Germ, endosperm, bran, hull | 1.0-20.2% | (Banas, <i>et al.</i> , 2007) |
| | Oat (Freja, Matilda) | Emrbyo and scutellum | 2.0-5.3% | (Banas, <i>et al.</i> , 2007) |
| | Oat (BDMY6, BDMY7, Che-chois, Y2330) | Germ, endosperm, bran, hull | 0.64% | (Musa Ozcan, <i>et al.</i> , 2006) |
| Linolenic (C18:3 (n-3)) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 0.9-1.3% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 0.9-1.1% | (Sterna, <i>et al.</i> , 2014) |
| Alpha-Linolenic (C18:3 all cis 9,12,15) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 1.2-1.6% | (Kourimska, <i>et al.</i> , 2018) |
| Linolenic (C18:3) isomers | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.1-0.4% | (Kourimska, <i>et al.</i> , 2018) |

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|-------------------------------------|--|---|-------------------|-----------------------------------|
| Arachidic (C20:0) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.2-0.4% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 0.2% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 0.2% | (Sterna, <i>et al.</i> , 2014) |
| Pauillinic (C20:1) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 0.6-0.8% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 0.7% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (9 cultivars) | Germ, endosperm, bran, +/-hull | 0.8-1.0% | (Brindzova, <i>et al.</i> , 2008) |
| | Oat (Freja, Matilda) | Germ, endosperm, bran, hull | 0.7-1.2% | (Banas, <i>et al.</i> , 2007) |
| | Oat (Freja, Matilda) | Emrbyo and scutellum | 0.7-1.7% | (Banas, <i>et al.</i> , 2007) |
| Eicosapentanoic (C20:5) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 0.2-0.4% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 0.2-0.3% | (Sterna, <i>et al.</i> , 2014) |
| Gondoic (C20:1 cis-11) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.8-1.1% | (Kourimska, <i>et al.</i> , 2018) |
| Eicosadienoic (C20:2 cis,cis-11,14) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | <0.1-1.5% | (Kourimska, <i>et al.</i> , 2018) |
| Behenic (C22:0) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.3-0.9% | (Kourimska, <i>et al.</i> , 2018) |
| | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, hull | 0.1% | (Sterna, <i>et al.</i> , 2014) |
| | Oat (S-156, 33793) | Germ, endosperm, bran | 0.1% | (Sterna, <i>et al.</i> , 2014) |
| Erucic (C22:1 cis-13) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | <0.1-0.1% | (Kourimska, <i>et al.</i> , 2018) |
| Lignoceric (C24:0) | Oat (Raven, Cavaliere, Korok, Kertag, Kamil, Patrik) | Germ, endosperm, bran, +/-hull | 0.3-0.5% | (Hamberg, <i>et al.</i> , 1998) |
| Avenoleic acid | Oat (Vital) | Germ, endosperm, bran, hull (Eluent choloroform) | 29% ^c | (Hamberg, <i>et al.</i> , 1998) |
| | Oat (Vital) | Germ, endosperm, bran, hull (Eluent Acetone) | 63% ^c | (Hamberg, <i>et al.</i> , 1998) |
| | Oat (Vital) | Germ, endosperm, bran, hull (Eluent Methanol) | 8% ^c | (Hamberg, <i>et al.</i> , 1998) |
| Galactolipid –avenolate complex | Oat (Vital) | Germ, endosperm, bran, hull | 0.5-0.6mg/g | (Hamberg, <i>et al.</i> , 1998) |
| Cholesterol | Oat (Vatter) | Leaves | 12.8% | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ, Endosperm, bran, hull | 2.8% | (Eichenberger, 1984) |
| | Oat (Vatter) | Germ and endosperm | 2.4% | (Eichenberger, 1984) |
| Saponins | | | | |
| Avenacoside A | oat | grains | 0.15-2.6 mg/100g | (Pecio, <i>et al.</i> , 2013) |
| | oat | kernel | 0.008-0.03% DW | (Önning & Asp, 1993) |
| avenacoside B | oat | grains | 0.06-2.51 mg/100g | (Pecio, <i>et al.</i> , 2013) |
| | oat | kernel | 0.003-0.01% DW | (Önning & Asp, 1993) |
| 26-desglucoavenacoside A | oat | grains | 0.07-0.7 mg/100g | (Pecio, <i>et al.</i> , 2013) |

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|-----------------|-----|----------|--------------|---------------------------|
| Total avenacins | oat | roots | 1280 mg/100g | (Mary & Crombie, 1986) |
| Total saponins | oat | Porridge | 130 mg/100g | (Tschesche & Wulff, 1973) |
| | oat | Porridge | 100 mg/100g | (Fenwick D. E, 1983) |

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PRISMA 2009 Checklist

| Section/topic | # | Checklist item | Reported on page # |
|------------------------------------|----|---|--------------------|
| TITLE | | | |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | 1 |
| ABSTRACT | | | |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | 2 |
| INTRODUCTION | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 5 |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 5 |
| METHODS | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | 6 |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 6 |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 6 |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | Supplement |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 6 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 7 |
| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 7 |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | n.a. |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | n.a |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis. | n.a |



PRISMA 2009 Checklist

| Section/topic | # | Checklist item | Reported on page # |
|-------------------------------|----|--|--------------------|
| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | n.a |
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | n.a |
| RESULTS | | | |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | 7 |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | 7 |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | n.a |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | n.a. |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | n.a. |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | n.a. |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | n.a. |
| DISCUSSION | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 7-17 |
| Limitations | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 17 |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 18 |
| FUNDING | | | |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | 19 |

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*Declaration of Interest Statement

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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A handwritten signature in blue ink, appearing to read "M. Glisic".