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1 **Consumer perception of situational appropriateness for fresh,**
2 **dehydrated and fresh-cut fruits**

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9

10 **Abstract**

11 In recent years, a decreasing trend in fruit consumption has been detected in
12 Mediterranean countries, with the consequent risk for the population's health. The
13 objective of this study was to obtain consumer knowledge that can be useful to promote
14 fruit consumption by designing specific interventions. This study was conducted in Spain
15 as its inhabitants have traditionally adhered to the Mediterranean diet. Firstly, four fresh
16 fruit types were identified based on the consumer perception of the fruit characteristics
17 that condition the eating process (fruit size, the need for cutlery to peel/eat fruit, and
18 susceptibility to be spoiled during transportation). Then consumer perception of
19 situational appropriateness of six different fruit types (the 4 types of fresh fruit previously
20 identified, dehydrated non-traditional fruit (DF), and fresh-cut fruit ready to eat on the go
21 (FCF)) was investigated by the Item-By-Use method using Check-All-That Apply
22 (CATA) questions. The potential of DF and FCF to broaden fruit consumption situations,
23 and barriers for their consumption, were evaluated. Fresh fruits, particularly 'easy-to-
24 peel' ones like mandarins or bananas, were those preferred by consumers in most
25 evaluated contexts. DF were considered mainly appropriate to be consumed 'As an
26 ingredient' and 'As a healthy snack', while FCF were more suitable 'To be included in
27 school lunchboxes' and 'To eat immediately'. According to our results, these two
28 processed fruit types can help to increase the fruit consumption of a non-negligible
29 percentage of the population (38 % of participants), but it is necessary to overcome the
30 barriers related mostly to sensory properties, plastic packaging and consumer
31 misperception of fewer healthy properties compared to fresh fruit.

32 **Keywords:** consumption context, Item-By-Use, CATA questions, eating process,
33 barriers, convenience

34 **1. Introduction**

35 Of all the eating patterns associated with different geographical areas, the Mediterranean
36 diet is a model based on traditional foods and drinks from countries surrounding the
37 Mediterranean Sea (Spain, Italy, Greece and others in the Mediterranean Basin). In recent
38 decades, this diet has been promoted worldwide as one of the healthiest diet patterns, and
39 is reported to be consistently beneficial for chronic diseases and longevity (García-
40 Fernández, Rico-Cabanas, Rosgaard, Estruch, & Bach-Faig, 2014). One of the key
41 features of the traditional Mediterranean diet is the large amount of fruit and vegetables
42 (FV) that it includes (La Vecchia & Bosetti, 2006). So interest is shown by non-
43 Mediterranean countries in increasing FV consumption in line with the Mediterranean
44 diet (Wang et al., 2014). However, a decreasing trend in FV consumption has been
45 detected in Mediterranean countries in recent years and, therefore, efforts to increase FV
46 consumption also need to be made in these countries (FEPEX, 2019; Leone, Battezzati,
47 De Amicis, De Carlo, & Bertoli, 2017).

48 Despite FV consumption having usually been evaluated together, in a recent study Verain,
49 Sijtsma, Taufik, Raaijmakers, and Reinders (2020) reported differences in the level of
50 fruit consumption and the level of vegetables consumption in different contexts. This
51 corroborates previous studies which have shown that the correlation between fruit
52 consumption and vegetable consumption is low and, therefore, independent approaches
53 are required to increase them (Naska et al., 2000). However, to our knowledge, only a
54 few studies have approached fruit consumption behaviours independently of vegetable
55 consumption, and the fact that such studies specifically focusing on fruit are lacking has
56 become more marked in the last decade compared to the previous one (Kremers, Brug,
57 de Vries, & Engels, 2003; Vereecken, Inchley, Subramanian, Hublet & Maes, 2005; Brug,
58 de Vet, de Nooijer & Verplanken, 2006; Briz et al., 2008; Groele, Głabska, Gutkowska
59 & Guzek, 2018). Therefore, the present study focused on aspects related to fruit
60 consumption rather than FV consumption.

61 In order to increase fruit consumption, it is necessary to understand consumer food
62 choices. For such research, we need to answer questions like when and why different
63 products are consumed. There are reports that the final decision to buy or consume a

64 particular food depends as much on the anticipated usage context as it does on intrinsic
65 product properties (Giacalone, 2019; Marshall, 1995; Ratneshwar & Shocker, 1991).
66 Hence the perceived situational appropriateness, defined as the extent of the match
67 between a product and the intended usage situations, has been demonstrated as a predictor
68 of consumer food choices (Giacalone & Jaeger, 2019).

69 Situational appropriateness is closely linked with the convenience concept, which refers
70 to the ease and adequacy of different food-related behaviours like shopping, storage, meal
71 composition, meal preparation (how and by whom), eating patterns, cleaning and waste
72 disposal (Swoboda & Morschett, 2001; Yale & Venkatesh, 1986). Convenience itself has
73 been shown to have an influence on consumer food choice (Costa, Schoolmeester,
74 Dekker, & Jongen, 2007).

75 We herein hypothesise that due to the particular characteristics of different fruit, which
76 condition their eating process (think, for example, about what we need to eat a
77 watermelon and what we need to eat grapes), the consumer perception of appropriateness
78 should differ among different fruit types and contexts. This fact is indirectly reflected in
79 previous studies on fruit consumption contexts: the appropriateness of fruit to be eaten as
80 a snack has been evaluated by Jack et al., (1997), the effect of familiarity with fruit in the
81 consumption context choice by Jaeger et al., (2005), and the characteristics of eating
82 occasions that contain fruit by Bava et al., (2012). Curiously enough in the three
83 aforementioned studies, the participants sample consisted only of women. Despite these
84 studies in the literature, the influence of the particular characteristics of different fruit on
85 consumer perception of situational appropriateness has never been directly approached.
86 We believe that understanding consumer perception in this sense may be extremely useful
87 for designing interventions to promote fruit intake, and we believe it is interesting to
88 include male and female consumers.

89 Furthermore, increasing food convenience has been one of the food industry's main
90 objectives in the last few years, and has been achieved mainly by processing food
91 products. This has led to consumers having available not only fresh fruit, but other fruit
92 types, on supermarket shelves. This is the case of fresh-cut fruit (FCF) ready to eat on the
93 go, which has been washed, cut, packed and refrigerated, and usually includes a fork to
94 help the eating process. Another fruit processing step that has been long since carried out,
95 and has been demonstrated to influence fruit convenience, is dehydration (Sijtsema,
96 Jesionkowska, Symoneaux, Konopacka, & Snoek, 2012). Traditionally, the dehydration

97 process has been applied to fruit types like grapes (raisins), dates, apricots or plums, and
98 this type has been reported to be used mainly as cooking ingredients (Sadler et al., 2019).
99 However in recent decades, “non-traditional dehydrated fruit” like apples, pineapples,
100 mangoes, kiwis, strawberries, among others, are available in the market, and less is known
101 about the situations for which consumers choose them.

102 Our second hypothesis in this study is that, due to the different product characteristics on
103 the whole, the situational appropriateness of fresh, dehydrated and FCF ready to eat, as
104 perceived by consumers, must differ. Therefore, these two relatively new products
105 (dehydrated non-traditional fruits (DF) and FCF ready to eat on the go) could contribute
106 to increased fruit intake by extending fruit consumption contexts in everyday life.

107 We investigated the validity of our hypotheses in Spain as its inhabitants have
108 traditionally adhered to the Mediterranean diet. Identifying the situations that consumers
109 consider are most appropriate for consuming different fruit types is interesting for
110 Mediterranean countries to promote fruit consumption and to, therefore, preserve people
111 adherence to their well-recognised healthy diet. Besides, this information can also be
112 useful for countries from other areas where fruit intake is lower to gain some clues about
113 daily life situations into which fruit consumption can be introduced and the fruit type that
114 is expected to be better accepted.

115 We paid special attention to determine the validity of our hypotheses in young adults as
116 different studies have reported that they are particularly at risk of inadequate fruit
117 consumption (Brookie, Mainvil, Carr, Vissers, & Conner, 2017). It has also been claimed
118 that increasing young adults’ fruit consumption may be particularly important as lifestyle
119 habits people develop during this life period are more likely to have long-term
120 consequences for their health (Hartman, Wadsworth, Penny, van Assema, & Page, 2013).

121 Finally, we investigated the barriers for consuming DF and FCF ready to eat on the go,
122 an aspect which unlike fresh fruit consumption barriers (Mc Morrow, Ludbrook,
123 Macdiarmid, & Olajide, 2017; Pinho et al., 2018) has not been approached and needs to
124 be investigated (Sadler et al., 2019).

125 All the information generated in this study is very valuable for developing public
126 interventions and campaigns about increasing fruit intake, and is especially useful for
127 companies that produce fresh, DF and FCF.

128 **2. Material and Methods**

129 This study was based on an online questionnaire via the platform Googleforms
130 (www.googleforms.com). The 433 participants were Spanish consumers, and recruitment
131 was designed to obtain 50% of the responses from *Young Adults* (18-25 years old); the
132 mean age and standard deviation (SD) of this group was 21 ± 2 years old. The age of the
133 other 50% of participants (*Adults*) ranged between 26 and 63 years old (mean age and
134 SD: 40 ± 11 years old). Participants were recruited using a variety of methods: 1) street
135 surveys using a tablet device, 2) Valencia University student mailing list, 3) consumer
136 database of IVIA. In addition, participants were requested to invite family, friends and/or
137 colleagues to participate by forwarding the online survey link. The opportunity to win
138 one of four commercial vouchers (€ 25) was used as an incentive for participation.

139 The questionnaire was structured into three parts: 1) in the first section, the participants
140 were shown six pictures with different fruit types and were asked about their situational
141 appropriateness by means of the Item-by-use (IBU) method using Check-All-That Apply
142 (CATA) questions; 2) in the second section, the participants were asked about their
143 consumption frequency of DF and their purchase frequency of FCF; 3) finally, the
144 barriers for consuming DF and FCF were investigated.

145 The protocol and procedures used in this study were revised by the scientific directorate
146 of Valencian Institute for Agricultural Research, which stated a waiver consent. All
147 articles from the Declaration of Helsinki and the 2016/679 EU Regulation on the
148 protection of natural persons regarding the processing of personal data and on the free
149 movement of such data were met. The experimental procedure was explained and a
150 written consent indicating voluntary participation was obtained from each participant
151 prior the beginning of the study.

152 **2.1. Situational appropriateness**

153 *2.1.1. Fruit types*

154 In the first part of the questionnaire, participants were shown six pictures with different
155 fruit types (Figure 1S):

156 a) Four pictures showing four different fresh fruit groups

157 1. Banana, apple, mandarin

158 2. Melon, pineapple, mango

159 3. Berries, strawberries, grapes, cherries

160 4. Kiwi, orange, persimmon

161 The criteria for selecting these four fresh fruit groups and the fruits included in each one
162 are explained in detail below.

163 b) A picture showing non-traditional DF (pineapple, strawberries, apples and mangoes
164 dehydrated with no added sugar)

165 c) A picture of FCF ready to eat on the go (two plastic cups containing fresh cut mixed
166 fruit ready to eat, including a disposable fork).

167 One of the hypotheses of this study was that not all fresh fruit would be equally
168 appropriate for different consumption contexts, due mainly to their distinct characteristics
169 as regards the eating process. Therefore, as a preliminary step of this study, groups of
170 fruits that shared similar eating processes were created according to consumer criteria.

171 To this end, individual interviews were held with eight people who stated eating fruit
172 daily. The group included five people between 18 and 25 years old and another three older
173 than 18. Consumers were given a list of the most habitual fruits consumed in the
174 Mediterranean region and were asked to choose those fruit that they would consume in
175 different daily life situations. They were asked about the reasons for their choice in order
176 to understand the common characteristics of the fruits that they selected for a specific
177 situation.

178 Apart from personal taste preferences, which were not herein considered, the main factors
179 that conditioned consumers' fruit choices depending on the consumption context were
180 fruit size, the need for cutlery to peel/eat fruit, which was also linked with the 'messy'
181 factor (need for napkins), and susceptibility to be spoiled during transportation.

182 Based on the interview results, four fruit groups were formed to be included in the final
183 questionnaire. The fruit included in the same group shared a similar consumption process:
184 1) 'Easy-to-peel fruit' - one-serving fruit, easy to transport, that does not need to be peeled
185 or is handy to peel (banana, apple, mandarin), 2) 'Big fruit' -big sized fruit that needs a
186 knife to be peeled or cut, and should be kept in the fridge if leftover (melon, pineapple,
187 mango); 3) 'Small fruit' - Small-sized fruits that are easy to eat without cutlery, and very
188 susceptible to be spoiled during transportation (berries, strawberries, grapes, cherries); 4)
189 'Cutlery-needed fruit' - One-serving fruit that needs cutlery for the eating process (kiwi,
190 orange, persimmon).

191 *2.1.2. IBU method using CATA questions*

192 Perceived situational appropriateness has been traditionally measured by the IBU method
193 by rating how suitable a product is considered over a range of use situations, typically on
194 a 7-point rating scale, ranging from “never appropriate” to “always appropriate” (Schutz,
195 1994). Recently, Jaeger et al (2019) demonstrated the usefulness of CATA questions to
196 perform IBU samples’ characterisation. In the IBU method using CATA questions,
197 consumers are provided a list of IBU terms; that is, a list of daily life contexts, along with
198 a group of stimuli (samples, pictures or sample descriptions). They have to select all the
199 situations which they consider appropriate for using/eating each sample. According to our
200 previous experience, CATA questions are easier and more convenient for consumers than
201 rating methods. So we used the IBU method with CATA questions in this study.

202 A preliminary IBU terms list was drawn up by the authors based on their own experience
203 and the existing literature (Jaeger et al., 2019). Then a group of eight consumers
204 participated in a session to generate the final list of IBU terms that would be included in
205 the CATA questions. The group included five people between 18 and 25 years old and
206 another three older than 18, including men and women. They were handed the six pictures
207 of the fruit that would be used in the final questionnaire and were asked to write down all
208 those contexts in which they would consume each fruit kind. They could use the
209 contexts/situations on the preliminary list, but were encouraged to suggest new situations
210 that were relevant for describing the evoked consumption context of each sample. These
211 eight consumers did not participate in the online questionnaire.

212 For all six pictures showing the different above-mentioned fruit, the participants were
213 asked: in which situations do you eat, or you think it is appropriate to eat, this fruit type?
214 They were provided a list with the following 12 IBU terms: As part of breakfast, lunch,
215 As a snack at home, As a snack to eat when I am not at home (at work, university,
216 travelling), In a school lunchbox, As dessert for lunch or dinner, To use for making fresh
217 juice or smoothies, As an ingredient (salad, baking, sauce, etc.), To take to a picnic, When
218 I practise sport, As a healthy snack, When I buy fruit to eat later in the week, When I buy
219 fruit to eat immediately. According to Meyners and Castura (2014), it may be desirable
220 to allow consumers to add a term that they perceive is missing, which was why the option
221 “Others” was included in the CATA questions at the end of the list. After selecting
222 “Others” consumers were asked to write down the missing terms.

223 Fruit images were presented in random order to avoid any sample effect and the IBU
224 terms were also randomised across consumers.

225 **2.2. Consumption/Purchase level**

226 After answering the CATA questions, the consumers were asked about their total fruit
227 consumption, their DF intake, and about their familiarity with FCF. The question about
228 global fruit consumption was linked with current intake recommendations; thus
229 consumers were asked: Do you consume five FV a day? (Response options: yes/no). DF
230 consumption was investigated by the question: Do you usually (at least once a month)
231 consume DF the same type you were shown in the picture? (Response options: yes/no).
232 With the FCF ready to eat on the go, as this product is relatively new on Spanish markets,
233 consumers were asked: Have you ever bought this fruit kind? (Response options: yes/no).

234 **2.3. Consumption barriers**

235 Those consumers who stated not consuming DF or never having bought FCF ready to eat
236 on the go were asked about their reasons for not doing so. To investigate such
237 consumption barriers, the consumers were given a list of reasons and were asked to select
238 all those they considered applied. As there is no specific literature on this matter for these
239 two fruit kind, these two lists were drawn up based on the previous literature about
240 consumer barriers for different products, mainly fresh fruit (Mc Morrow et al., 2017;
241 Pinho et al., 2018), and the final list was designed by the authors. The list of reasons for
242 not consuming DF included: I like the fresh fruit taste the best, They are not available
243 where I usually shop, I don't like those I've tasted, They are more expensive than fresh
244 fruit, I think they are less healthy than fresh fruit, I think they contain more sugar than
245 fresh fruit, I haven't tasted them, I think they contain additives. At the end of the list, the
246 option "Others" was included so that the consumers could indicate any other missing
247 reason.

248 The reasons for having never bought FCF included on the final list were: They are more
249 expensive than fresh fruit, They are not available where I usually shop, I haven't tasted
250 them, I prefer preparing cut fruit myself, I don't know when it was prepared, I think fruit
251 may have lost vitamins. Once again, the option "Others" was included.

252 It is necessary to clarify that the consumption barriers for fresh fruit were not evaluated
253 in this study because being a habitual fresh fruit consumer was a requirement to
254 participate in it.

255 Finally, the consumers indicated their gender and age. Fifty-three percent of the
256 participants were women and 47% were men.

257 **2.4. Statistical Analysis**

258 To analyse the data, different non-parametrics tests were performed. The Cochran's Q
259 test and the McNemar (Bonferroni) test for multiple comparison pairs was performed to
260 identify significant differences between samples for each context included in the CATA
261 questions. Then a Correspondence Analysis (CA) was carried out with the frequencies of
262 mentioning the contexts for each sample to establish the more relevant differences among
263 the six fruit types according to their consumption appropriateness as perceived by the
264 consumers. The two-proportions z-test was used to compare the frequencies of
265 mentioning the contexts for each sample depending on the participants' age. All the
266 analyses were performed with XLStat 2010 (Addinsoft, Paris, France).

267 **3. Results and Discussion**

268 **3.1. Main fruit consumption contexts**

269 In order to identify those contexts in which Spanish people consume or consider it
270 appropriate to consume fruit, irrespectively of fruit type, the number of participants who
271 checked each context was calculated regardless of the sample (Figure 1). We observed
272 that, except for 'When I practise sport' and 'When I buy fruit to eat immediately', all
273 other contexts were checked by more than 75% of the participants for some samples.
274 Among them, the most checked contexts were 'As part of breakfast, lunch' and 'As
275 dessert in lunch or dinner' which were selected by 95% of the participants.

276 All the contexts were more frequently mentioned by the segment of young adults
277 compared to adults, indicating that, in general, young people are prone to eat fruit in more
278 varied occasions of the daily life compared to adults (data not shown). Statistical analysis
279 revealed slight differences depending on the participants' age (Table 1S). Those
280 consumption contexts that young people selected more frequently than older adults were:
281 'When I practise sport', 'As a healthy snack', 'To use for making fresh juice, smoothies'
282 and 'When I buy fruit to eat immediately'. Identification of daily life contexts that young

283 people considered especially appropriate for fruit consumption may help to approach
284 strategies to enhance their fruit intake. Thus, for example, offering fruit in coffee bars or
285 vending machines in gyms, sport centres or university sport facilities where young people
286 practice sport could be a good strategy.

287 Our results generally suggest that, although fruit consumption was mainly associated with
288 main meals (breakfast, lunch and dinner), most participants considered it appropriate to
289 eat fruit in very different daily life situations. Hence fruit seems to play a relevant role in
290 the Spanish population's whole dietary habits, or at least in their conception of
291 appropriate habits, irrespectively of age.

292 Notwithstanding, when the participants were asked if they followed the recommendation
293 of "5 a day", only 57% of them stated they did. So according to this result, the FV intake
294 of a significant number of participants (43%) was below that recommended. These values
295 fall in line with previous findings (Leone et al., 2017), which indicate that even in
296 countries that follow the Mediterranean diet, there is a decreasing trend FV consumption,
297 and nutritional recommendations are not being followed. A comparison of "5 a day"
298 consumption between young and older adults revealed that this intake recommendation
299 was followed by more older (59.5 %) than young (54.6 %) adults. Therefore, although
300 younger people more often consider it appropriate to eat fruit than older people, they do
301 not actually consume more fruit.

302 **3.2. Differences in the situational appropriateness among different fruit types**

303 *3.2.1. Check All That Apply questions*

304 Table 1 shows the frequency of mentioning the contexts in which the participants
305 considered it appropriate to eat different fruit types: fresh fruit (big-sized fruit, needs
306 cutlery fruit, small-sized fruit, easy-to-eat fruit), FCF and DH. The most often mentioned
307 contexts were 'As dessert in lunch or dinner', 'As part of breakfast, lunch', 'When I buy
308 fruit to eat later in the week', 'In a school lunchbox'.

309 A Cochran's Q test was performed to analyse if the appropriateness perception of the
310 different fruit types depended on the consumption context. The results showed that the
311 12 evaluated contexts presented significant differences in the frequency of mention
312 among samples ($p < 0.001$); that is to say, the contexts in which consumers found it
313 appropriate to eat fruit depended on the sample; i.e. fruit type.

314 Subsequently, a CA was performed on the 12 studied contexts by taking into account the
315 six fruit types (Figure 2). The first two CA dimensions explained 94.23% of the overall
316 variability of the dataset by considering the first and second dimensions for 74.85% and
317 19.38% of variability, respectively.

318 The different fruit types were distributed mainly along the first dimension. Big-sized fruit
319 and cutlery-needed fruit were displayed on the left side of the plot, close to one another,
320 and the participants considered them appropriate ‘To be consumed later in the week’, ‘To
321 be used for making fresh juice or smoothies’, and ‘To be eaten as dessert in lunch or
322 dinner’, or ‘As part of breakfast and lunch’. Both FCF and DF were conversely allocated
323 on the right side of the plot, and were more frequently associated with the following
324 contexts ‘As a snack to eat when I am not at home’, ‘To take to a picnic’, ‘In a school
325 lunchbox’, ‘When I buy fruit to eat immediately’ and ‘As a healthy snack’. Therefore, the
326 participants found that big-sized fruit and fruit that need cutlery were more suitably eaten
327 as part of main meals when at home, while they perceived FCF and DF more convenient
328 to eat when they are out. This result agrees with Verain et al. (2020) who concluded that
329 convenience was much more important for snacks and for out of home contexts compared
330 to main meals at home.

331 Finally, small-sized fruit and easy-to-peel fruit were displayed close to one another, and
332 also near the origin of the coordinates, which indicates that they were generally
333 appropriate to be eaten in most of the proposed contexts.

334 The analysis of the CA plot in more detail revealed some differences between DF and
335 FCF along the second dimension. DF was perceived as being more suitable ‘As an
336 ingredient (salad, baking, sauce, etc.)’ and ‘As a healthy snack’, while FCF was more
337 appropriate to be included in school lunchboxes and also to be eaten immediately.

338 On the one hand, people’s perception of DF as an ingredient is probably linked with the
339 fact that the dehydration process was initially applied mainly to traditional fruits (raisins,
340 apricots, etc.) used in the food industry (or homemade preparations) to make breakfast
341 cereals, bakery, desserts and confectionery products (Megías-Pérez, Gamboa-Santos,
342 Soria, Villamiel, & Montilla, 2014). However, in the last two decades, different studies
343 have approached the dehydration process of non-traditional fruits, such as pineapple,
344 mango or apples, to be consumed as snacks (Perez-Tinoco, Perez, Salgado-Cervantes,
345 Reynes, & Vaillant, 2008; Sham, Scaman, & Durance, 2001; Zou, Teng, Huang, Dai, &
346 Wei, 2013). Such studies have more recently covered other tropical fruits like jack fruit,

347 pitaya, papaya or persimmon (Jia et al., 2019; Yi et al., 2016; Yi, Lyu, Bi, Zhou, & Zhou,
348 2017). Introducing non-traditional DF as an alternative to traditional, high-calorie and
349 unhealthy (high fat and high sugar contents) snacks is industry's response to consumer
350 demand of quality, healthy and easy-to-eat food products (Scholliers, 2015; Stranieri,
351 Ricci, & Banterle, 2017). Accordingly, our results showed that consumers perceived DF
352 as an alternative healthy snack and, therefore, this new way of consuming fruit seems a
353 good option to increase fruit intake.

354 On the other hand, appropriateness of FCF to be included in school lunchboxes must be
355 related to the healthy properties of fruit and parents' concern about children's nutrition
356 (Stranieri et al., 2017). In fact, it has been demonstrated that adults are more willing to
357 make healthier purchases for their children than for themselves (Tandon, Wright, Zhou,
358 Rogers, & Christakis, 2010). In urban environments, modern lifestyles tend to limit
359 consumers' time availability (Botonaki & Mattas, 2010; Brunner, van der Horst, &
360 Siegrist, 2010), and they seek convenience and minimally processed FV to help them to
361 manage time and still benefit from their healthy characteristics (Stranieri et al., 2017).
362 Clearly, the FCF convenience that is ready to eat makes the eating process easier for
363 children, while saving parents' time.

364 *3.2.2. Potential of dehydrated and fresh-cut fruit to increase fruit consumption*

365 The CA is a very useful tool that provided us with an overview of consumer perceptions
366 of each fruit appropriateness type depending on the consumption context. It revealed
367 specific situations in which, comparatively, DF and FCF were considered more
368 appropriate to be eaten than fresh fruit.

369 Beyond that, we studied the data in more detail to investigate to what extent DF and FCF
370 could contribute to broaden daily fruit consumption contexts apart from fresh fruit. Hence
371 for each context, the frequencies of mentioning fresh, DF and
372 FCF were compared. To do so, the four fresh fruit types evaluated in this study (big-sized
373 fruit, needs cutlery, small-sized fruit and easy-to-peel fruit) were merged to form a single
374 group called 'fresh fruit', and in such a way that for any context, if a participant had
375 checked more than one fresh fruit type, only one count was considered. The results of this
376 analysis, expressed as a percentage of participants, are shown in Figure 3.

377 *A priori*, data could suggest that neither DF nor FCF are an option to enhance fruit
378 consumption as fresh fruit was deemed appropriate for all the evaluated contexts by a

379 higher percentage of consumers than DF and FCF. However, when we analysed the
380 CATA counts by taking into account the factor “participant”, the results were quite
381 revealing (data not shown). Of the participants who declared it appropriate to consume
382 fruit as ‘a healthy snack’, there was a significant number of them, 20%, who only stated
383 that DF was appropriate. That is to say, this consumer group would only choose DF as an
384 alternative to traditional snacks. Similarly, of the participants who would consume fruit
385 ‘As an ingredient’ or ‘As a snack at home’, ‘As a snack out of home’, or ‘In a picnic’, a
386 significant group of them, 12% and 7%, respectively, would only consume dehydrated
387 fruit in such situations. The data study, which took into account all these contexts and the
388 participant factor, showed that for 142 participants (33 % of the total) DF was an
389 alternative to broaden fruit consumption contexts in relation to only fresh fruit
390 availability.

391 In parallel, in some contexts, especially ‘As a healthy snack’ and ‘In a picnic’, a group
392 with 10% of the consumers declared that FCF would be the only fruit type that they would
393 choose to be consumed in such situations. Despite obtaining a lower percentage, FCF
394 were also revealed as the only fruit type to be included in lunchboxes for 3 % of the
395 consumers. By adding the total number of these participants (68 people who would choice
396 only FCF in certain contexts) to those that would choice only DF (142 participants), and
397 taking into account that 46 of them were present in both groups, we estimated that the
398 two fruit types together would broaden the fruit consumption contexts of 164 consumers,
399 i.e. 38% of all the participants.

400 Therefore, our results showed that even though fresh fruit was the fruit type to be more
401 often considered appropriate in the different daily life situations, there are specific
402 situations in which, for a non-negligible amount of consumers, DF and FCF would be the
403 only option to eat fruit. Therefore, these two processed fruit types could contribute to
404 increase people’s fruit intake. It is worth mentioning that all these consumption contexts
405 were out-of-home situations. Several studies have pointed out the need to improve the
406 convenience of food products to help consumers include healthy products in today’s fast
407 and stressful daily life (Botonaki & Mattas, 2010; Brunner et al., 2010), and DF and FCF
408 seem good options to meet this need.

409 *3.2.3. Consumption barriers of dehydrated and fresh-cut fruit*

410 As mentioned in the Introduction section, many studies have approached the
411 identification of barriers for fresh fruit consumption (Mc Morrow, et al., 2017; Pinho et
412 al., 2018). However, as recently pointed by Sadler et al (2019), there is a gap in the
413 information on this matter for DF. To our knowledge, the situation is the same for FCF
414 ready to eat on the go. Therefore, as the final questionnaire part, the participants were
415 asked about their eating/purchasing habits of DF and FCF, and their main reasons for not
416 consuming these two fruit types.

417 Regarding DF, the participants were asked if they usually (at least once a month) consume
418 it. Nineteen percent of the participants stated that they were usual consumers of DF. It
419 may seem a low percentage of consumers, but it is important to bear in mind that the
420 participants in this study were shown non-traditional DF (mango, strawberries, pineapple
421 and apple with no added sugar), which have only been more recently available than
422 traditional DF. Those participants that stated not being usual consumers of this fruit kind
423 were provided with a list of consumption barriers and asked to check everything that
424 applied to them. Figure 4 shows the percentage of consumers who mentioned every
425 reason provided on the list.

426 Our results revealed sensory properties of non-traditional DF as the main barrier to eat it
427 (70% of the participants), mainly because consumers preferred the taste of fresh fruit.
428 Moreover, 20% of the participants stated that they did not like the DF they had tasted.
429 Other less frequently mentioned reasons (10-18% of the participants) were: ‘They are
430 more expensive than fresh fruit’, ‘I think they are less healthy than fresh fruit’, ‘They are
431 not available where I usually shop’, ‘I have not tasted them’, ‘I think they contain more
432 sugar than fresh fruit’, ‘I think they contain additives’.

433 According to Verain et al. (2020), taste is one of the factors that most strongly influences
434 fruit choice. Our findings fall in line with this as the main barrier for not consuming DF
435 is related to its taste, which is less liked compared to fresh fruit or it is simply not liked.
436 In recent years, considerable research has been conducted on the effect of different drying
437 technologies on the physico-chemical properties of DF (Jia et al., 2019; Megías-Pérez et
438 al., 2014; Sham et al., 2001; Yi et al., 2016; Yi et al., 2017). Although this is valuable
439 information, less attention has been paid to sensory properties. A few studies have used
440 trained panels to describe sensory properties of the obtained DF (Jia et al., 2019; Yi et al.,
441 2016; Yi et al, 2017). However, in general, consumer studies have not been included.

442 Apart from identifying fruit taste as the main barrier, price was also a limitation for
443 consumption. Thus DF was perceived as more expensive than fresh fruit for a significant
444 group of participants. However, we must bear in mind that the portion size of DF is
445 smaller than that of fresh fruit. Some marketing strategies may help to overcome this
446 barrier, such as providing consumers with information about the equivalent fresh fruit
447 portion. In fact, some companies have adopted this strategy and, for example, some
448 packages of dehydrated apples (20 g) indicate “Equivalent to a whole apple”.

449 Three barriers herein identified were related to consumer perception of DF as not being
450 completely healthy: ‘I think they are less healthy than fresh fruit’, ‘I think they contain
451 more sugar than fresh fruit’ and ‘I think they contain additives’. Such consumer concerns
452 about the healthy character of DF are mainly unfounded as their content of nutrients after
453 the drying process are the equivalent to fresh fruit, albeit more concentrated, except for
454 having a lower vitamin C content. So DF are high in a range of dietary fibres and other
455 bioactive compounds with prebiotic effects (e.g. polyphenols) (Sadler et al., 2019). Thus
456 our results corroborated two current challenges suggested by Sadler et al (2019), namely
457 consumers understanding the different DF types and correcting the general misconception
458 of most DF containing added sugars. However, it is important to bear in mind that the
459 dehydration process implies sugar concentration. After the dehydration process, sugar
460 content is the equivalent of fresh fruit, but the content per 100 g of product is higher. This
461 fact must be taken into account for calculating serving sizes, especially for people with
462 sugar intake restrictions. Clear messages on fruit packages with lists of ingredients and
463 nutrition information are likely to help consumers to choice among different DF types.

464 It is worth mentioning the barrier ‘they are not available where I shop’. While this study
465 was being conducted, the main supermarkets in Valencia were visited. Valencia is a city
466 with 1 million inhabitants located on the Mediterranean coast. It can be considered
467 representative of medium-big-sized Spanish Mediterranean city. In all the visited
468 supermarkets, some kind of non-traditional DF was available. However, we realised that
469 there was no set section on supermarket shelves for them. Depending on the supermarket,
470 they were found with nuts, close to fresh fruit, with pastry products, close to diet products,
471 etc. Strangely enough, they were never located with traditional snacks like crisps.
472 Therefore, the authors believe that it is quite likely that consumer perception of lack of
473 availability was motivated by this situation, at least for some participants.

474 Regarding FCF ready to eat on the go, this product is well established in countries like
475 Italy and The Netherlands, but is still emerging in other countries like Germany and Spain
476 (Baselice, Colantuoni, Lass, Nardone, & Stasi, 2017). Thus with FCF, consumers were
477 not asked about consumption frequency, but were asked if they had ever bought this fruit
478 kind. Our results indicated that 54% of the participants had bought FCF, while 46% had
479 not.

480 More than 75% of the participants who had never bought FCF stated that it was because
481 they preferred preparing fruit themselves (Figure 4). Behind the fact that people prefer
482 preparing fruit themselves may lie the other identified barriers. Thus its higher price
483 compared to fresh fruit and the two aspects related to health concerns (I don't know when
484 it was prepared and I think fruit may have lost vitamins) were identified as the main
485 barriers for a relevant number of participants (25-40%). Similarly to DF, it is also
486 necessary with FCF to inform consumers that fruit processing has no negative effect on
487 the nutritional value of fruit.

488 Nutritional changes in a wide range of FCF (pineapple, mangoes, watermelon, melon,
489 strawberries, kiwis) stored at 5°C for up to 9 days were evaluated by Gil, Aguayo, and
490 Kader (2006). These authors compared the changes in FCF to those that took place in
491 fruit stored whole and then cut. Their study revealed that nutritional changes in cut fruit
492 during storage were similar to those of whole fruit. Shelf life based on external FCF
493 quality depended on fruits. Kiwis cannot be stored longer than 6 days, while watermelons
494 and mangoes can be stored for up to 9 days. In general, visual spoilage of FCF occurs
495 before any significant nutrient loss.

496 It is also worth mentioning that 12% of the participants stated that the plastic-made
497 package was a reason for not buying this fruit kind. This barrier related to packaging
498 material was not initially included on the list, but a significant number of participants
499 wrote down this reason in the "Others" Option. This barrier clearly shows growing
500 consumer awareness of their purchasing decisions having an environmental impact
501 (Lindh, Olsson, & Williams, 2016).

502 Currently, the production and use of biopolymers (bio-based and biodegradable
503 polymers), and other materials like biocomposite, are increasingly leading the food
504 packaging sector to reduce the use of non-renewable resources and prevent plastic waste
505 accumulation (Arrieta, Samper, Aldas, & López, 2017; Sánchez-Safont, Aldureid,

506 Lagarón, Gámez-Pérez, & Cabedo, 2018). The use of alternative materials for FCF could
507 represent a valuable solution to overcome the barrier related to consumers' environmental
508 concerns.

509 Finally, we investigated if there were any differences among young adults and adults in
510 the main consumption barriers for DF and FCF. Our results showed that participants' age
511 had no effect on the evaluated barriers.

512 *3.2.4. Study limitations and future research*

513 This study compared consumer perceptions of situational appropriateness of three
514 different fruit types (fresh, DF and FCF). Different factors that condition the consumption
515 context of fresh fruit were identified and taken into account for the survey design. Thus
516 four different groups of fresh fruit were evaluated. Moreover, the influence of factors like
517 gender and age were examined. However, other factors like participant familiarity with
518 the different fruit types, participant level of income and even liking differences among
519 fruit types, could influence consumer perceptions of situational appropriateness (Jaeger
520 et al., 2005; Konttinen et al., 2012, Giacalone & Jaeger, 2016). In the present study, these
521 confounding factors could be especially relevant for FCF and DF as our results showed
522 that participants were less familiar with these two relatively new products than with fresh
523 fruit. Moreover, the higher price and lower taste preferences for DF and FCF compared
524 to fresh fruit were among the identified barriers for consumption. Therefore, it is likely
525 that these factors, familiarity, level of income and liking, all influence consumer choice
526 of the different fruit types for the evaluated consumption context.

527 Another limitation of this study is that participants should ideally evaluate the same fruit
528 under all three conditions (fresh, dehydrated, fresh-cut). However, this study followed a
529 more global approach insofar that different dehydrated and fresh-cut fruit were presented
530 together as one "fruit type". One of the main reasons for this is that FCF is habitually
531 commercialised as a mixture of different fruits.

532 Having identified the main consumption barriers, the evaluation of different strategies to
533 overcome them should be addressed in future research. Our results clearly suggest a need
534 to keep working to improve the sensory characteristics of DF and to include consumer
535 panels in studies to guarantee a certain level of acceptance before producing new products
536 to be marketed (Mora et al., 2020). Besides, the influence of different claims and label
537 information on consumer purchase intentions of both DF and FCF must also be

538 investigated. For FCF, apart from evaluating the effect of different packaging materials
539 on fruit quality, studying the influence of packaging itself on consumer purchase
540 intentions would be interesting.

541 **4. Conclusion**

542 This is the first study to compare situational appropriateness among different fresh fruit
543 types and processed fruit (DF and FCF). For fresh fruit, size, the need to use cutlery to
544 peel/eat fruit, and susceptibility to be spoiled while being transported were identified as
545 the determinant characteristics for situational appropriateness. Accordingly, consumers
546 selected different contexts as appropriate to consume ‘big-sized fruit’, ‘needs cutlery
547 fruit’, ‘small-sized fruit’ and ‘easy-to-eat fruit’. Among these fruit types, the ‘easy-to-
548 peel’ ones like mandarins or bananas were highlighted by being appropriate to be eaten
549 in most evaluated contexts. Consumers found DF suitable to be consumed ‘As an
550 ingredient’ and ‘As a healthy snack’, while FCF were more appropriate ‘To be included
551 in school lunch boxes’ and ‘To eat immediately’. Knowing consumer perceptions of the
552 situational appropriateness of different fruit types may be very useful for approaching
553 public interventions and campaigns that could include increasing the availability of
554 specific fruit types in certain contexts. According to this study results, DF and FCF may
555 contribute to significantly broaden the fruit consumption contexts. However, more
556 research is needed to overcome the barriers related mostly to unsatisfactory sensory
557 quality, plastic packaging and consumer perception of healthy properties loss linked with
558 processing. The consumption barriers herein identified are key information because they
559 can point out the strategies that can be followed to help make DF and FCF more
560 acceptable for a higher percentage of the population.

561

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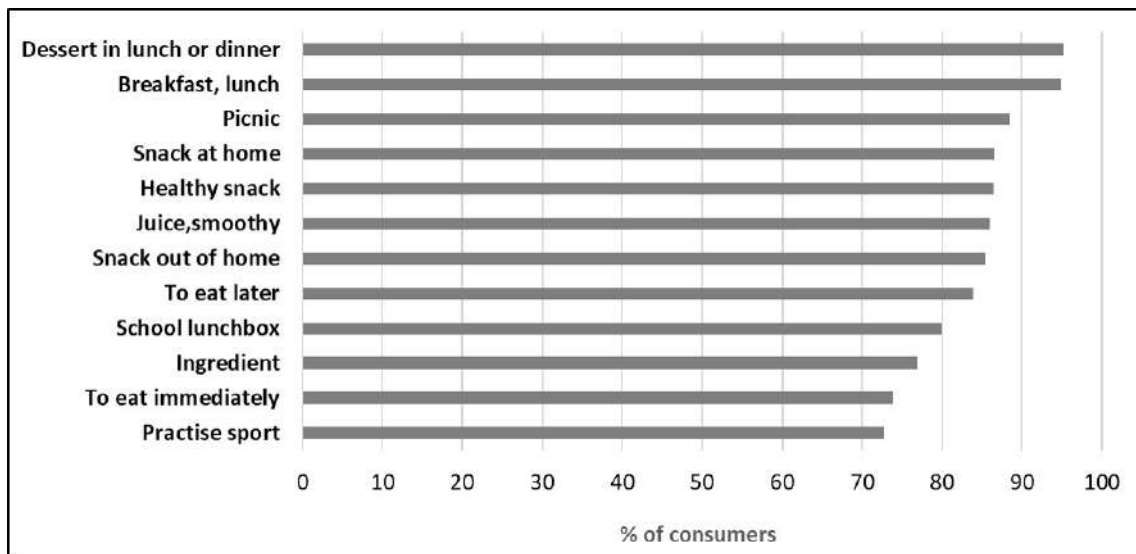
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768 **Figures**

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771 **Figure 1. Main fruit consumption contexts.** Percentage of participants who checked
772 each context for any presented fruit type.

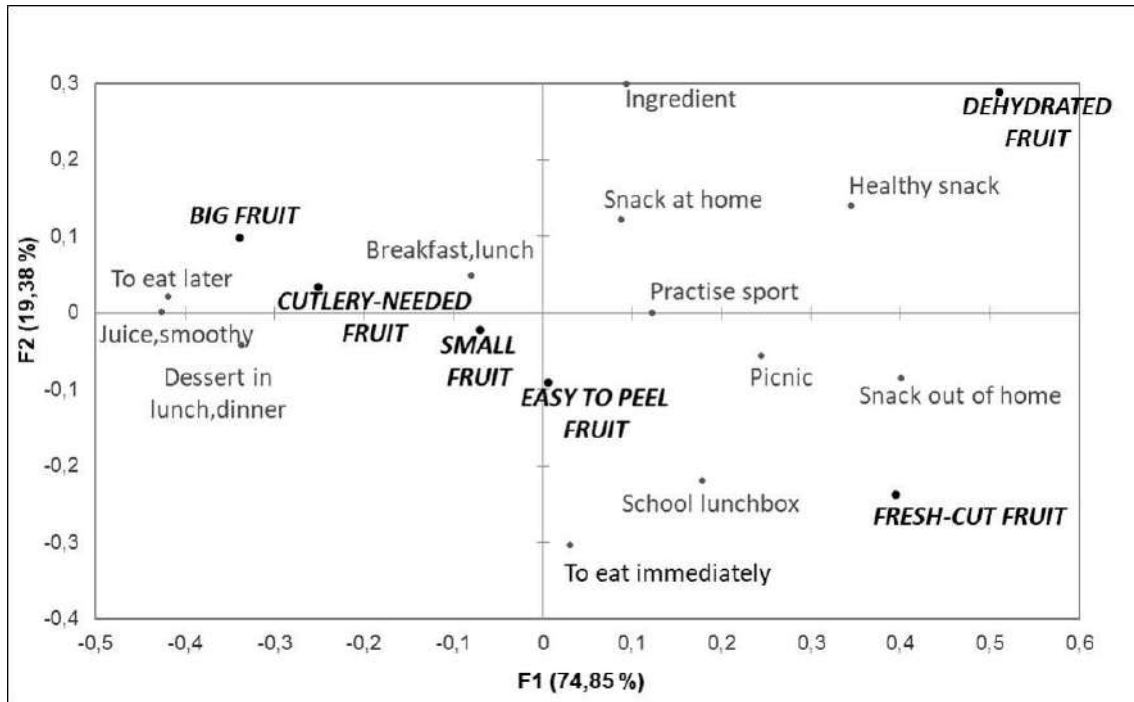
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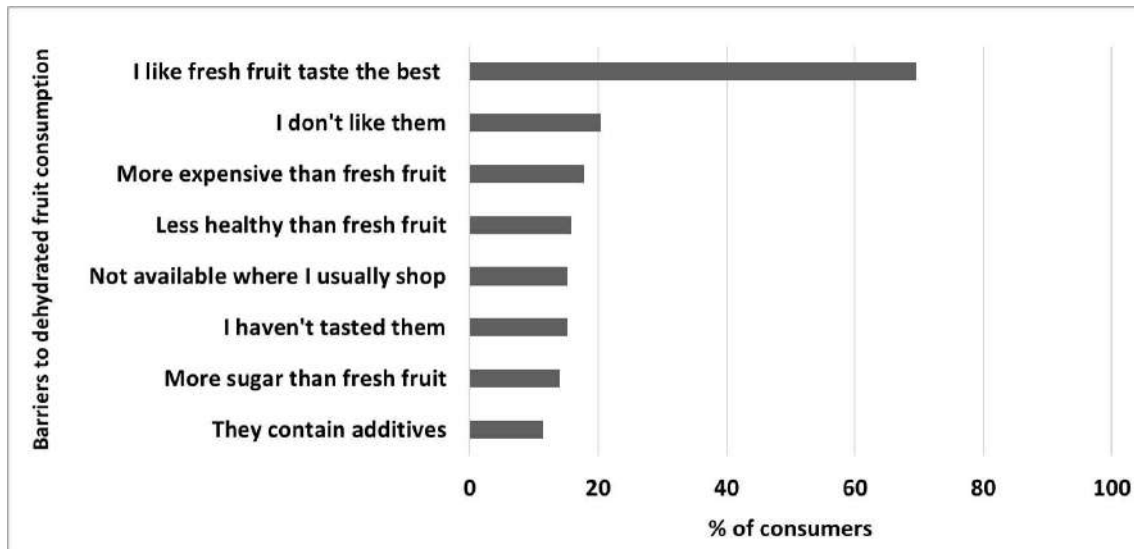


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779 **Figure 2. Correspondence Analysis.** Correspondence Analysis performed with the
 780 CATA counts. Samples are denoted in capital letters and contexts are denoted in
 781 lowercase letters.

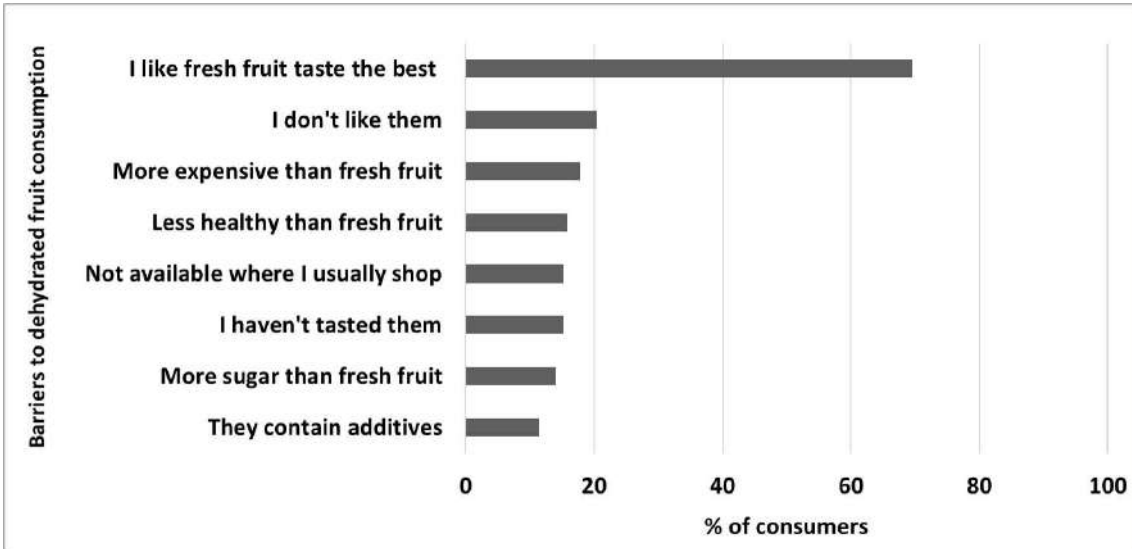
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785 **Figure 3. Consumption context for fresh fruit, DF and FCF.** Percentage of consumers
 786 who eat or consider appropriate consuming the different fruit types in the proposed
 787 contexts. The fresh fruit group is made up of the consumers who checked any of the four
 788 evaluated fresh fruit types (small, easy-to-peel fruit, needs cutlery fruit and big fruit).



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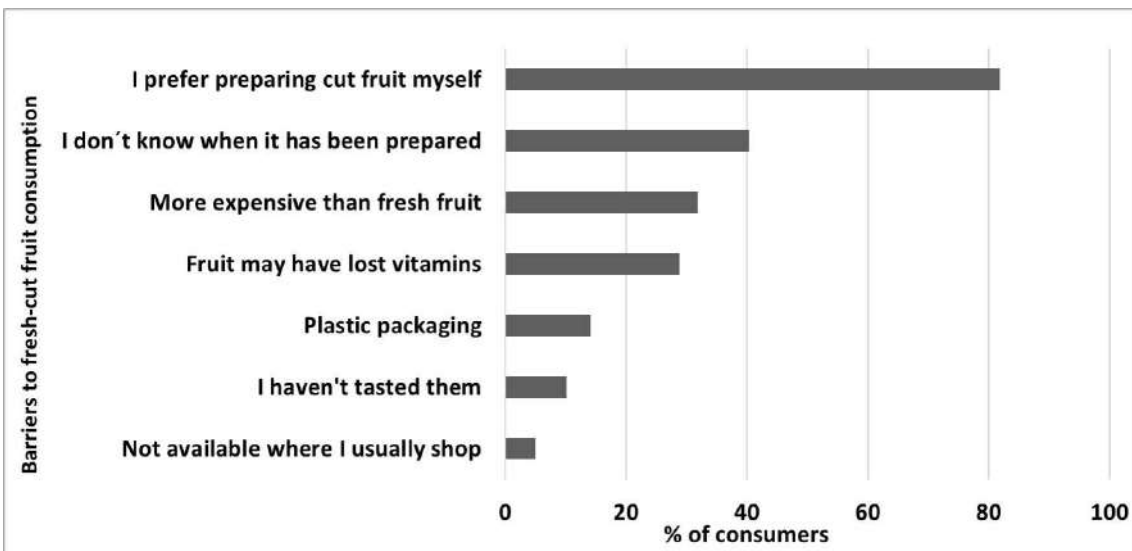
790 **Figure 4. Consumption barriers of DF.** Consumption barriers of dehydrated fruit for
 791 the participants (%) who stated not regularly consuming non-traditional dehydrated fruit

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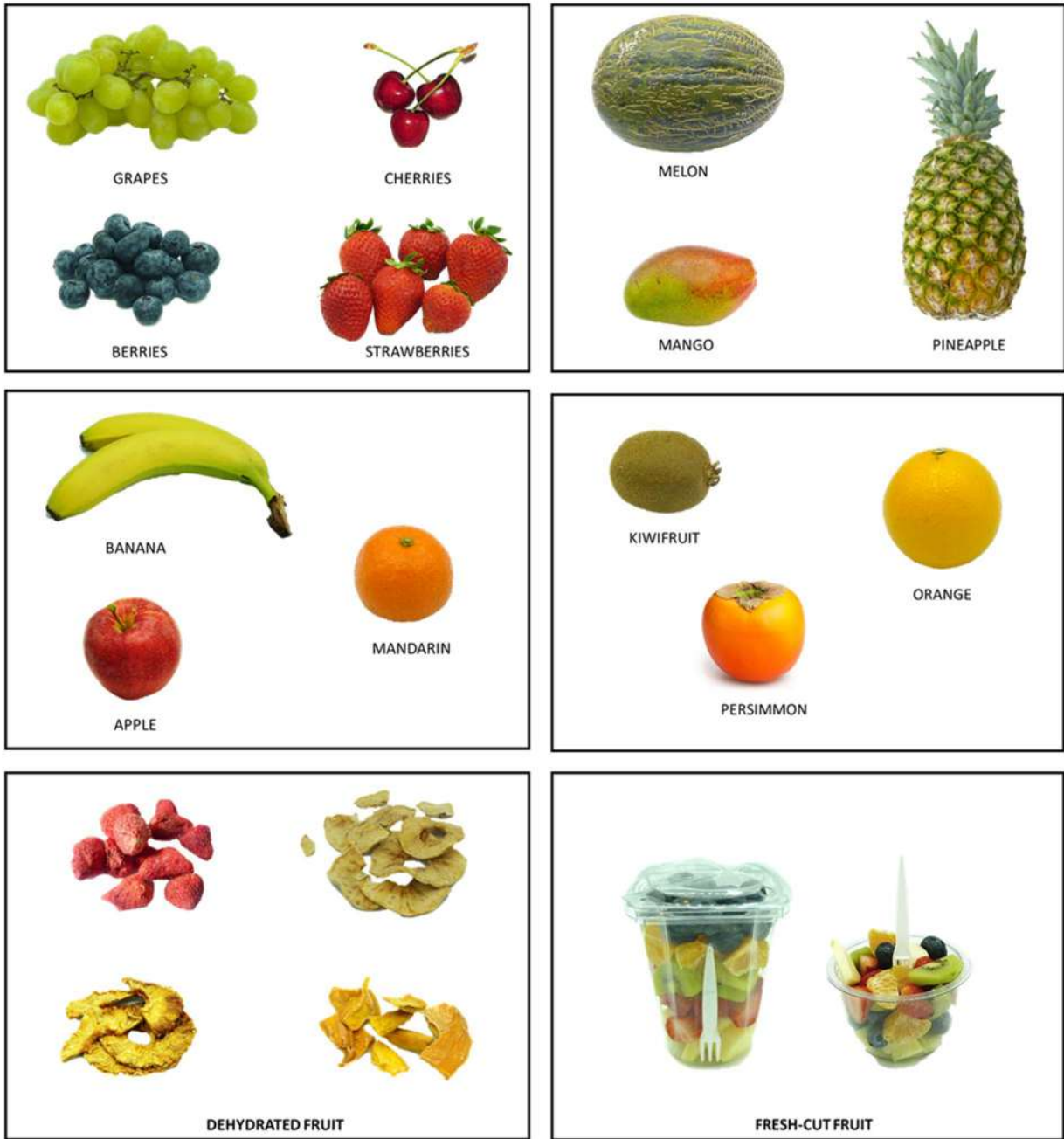


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797 **Figure 5. Consumption barriers of FCF.** Consumption barriers of fresh-cut fruit for the
 798 participants (%) who stated never having bought it.

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802 **Figure 1S. Images of the different fruit types used in the questionnaire**

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809 **Table 1S. Results of the z-test for comparison of two proportions ($\alpha=0.05$).**
 810 Significant differences in the frequency of mention of the different fruit consumption
 811 contexts between young adults (18-25 years old) and adults (26-63 years old) are
 812 indicated by * and bold font. The total number of young and adult participants were 216
 813 and 217 respectively.

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CONTEXT	Young (counts)	Adults (counts)	z-value (observed)	z-value (critical)	p-value
Dessert in lunch or dinner	206	206	0.00	1.96	1.000
Breakfast, lunch	208	203	1.09	1.96	0.278
Picnic	197	186	1.64	1.96	0.100
Snack at home	190	185	0.69	1.96	0.492
Healthy snack *	199	175	3.39	1.96	0.001
Juice, smoothy *	197	175	3.06	1.96	0.002
Snack out of home	188	182	0.80	1.96	0.424
To eat later	189	174	1.95	1.96	0.051
School lunchbox	181	165	1.21	1.96	0.226
Ingredient	175	158	1.92	1.96	0.055
To eat immediately *	171	149	2.40	1.96	0.017
Practise sport *	172	143	3.14	1.96	0.002

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