

Knowledge and Attitude towards Label claim of dark Chocolates among Customers of Oman-- Cross Sectional Survey

Comment [H1]: Should include the relation with health benefits

5 Abstract

6 Dark chocolate is one of the most studied foods in the recent period due to its potential effects and health
7 benefits. Admittedly, people's attitude and acceptance of dark chocolate is still unknown. The cross-sectional
8 study was aimed to determine the usage and effect of dark chocolate on the health. It also aimed to study the
9 attitude of young adults in Oman towards the consumption of dark chocolate, and to discover the most
10 preferred brands of DC in the Omani market. The study was conducted from spring 2020 to Fall 2022 in
11 Oman. Two types of surveys were conducted. Firstly, a product survey was done to compare between some
12 brands according to the price, ingredient, expiry date, and country of origin. Secondly, a cross sectional-based
13 survey was done focusing on health benefits upon consuming dark chocolate. 345 respondents participated in
14 completing this survey. The results proved that many people are now aware of the health benefits of dark
15 chocolate. Majority of the participants expressed their knowledge of the health aspect of dark chocolate and
16 their interest in choosing the best product by examining the ingredients - especially the cocoa percentage- of
17 the product before purchasing.

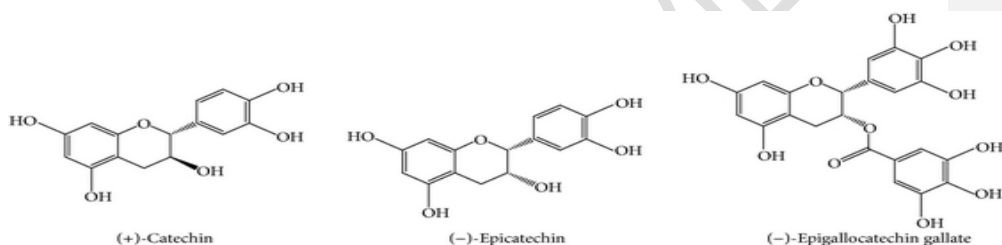
18 **Keywords:** Dark chocolate, health benefits, attitude, label claim, polyphenols

19 1. Introduction

20 The cardiovascular effect of flavonoids appears to be through elevating the bioavailability of nitric oxide thus
21 it works on protecting vascular endothelium and reduce the risk factors of cardiovascular disease (CVD).
22 Moreover, insulin resistance might be improved by flavonoids and related antioxidant action of polyphenol by
23 increasing nitric oxide endothelial level and decreasing reactive oxygen formation. The in-vitro studies suggest
24 that polyphenols will act on the inhibition of IκB kinase and downregulating the nuclear factor-κB which are
25 sensitive signal in redox transduction pathway that take a place in endothelial injury cascade and involved in

26 insulin resistance induced by fat [1]. On the other hand, in-vivo studies revealed that flavonoid complex called
27 silymarin provide a glycemic control along with reducing both fasting insulin and the requirement of
28 exogenous insulin in type 2 diabetic patients receiving therapy.

29 DC is flavonoids' rich delight has high cocoa percentages ranging from 70% to 99%, which are responsible for
30 its bittersweet taste. The main type of flavonoids present in dark chocolate is flavanol which is also found in tea.
31 Flavonoids belongs to the polyphenol family that mediate the effects of DC in cardiovascular disease (CVD).
32 On the other hand, fresh cocoa bean has (-)-epicatechin as major polyphenol compound within the range of 21–
33 43 mg/g followed by the (+)-catechin, along with dimers and trimers of the previous compounds [2]



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36 Dark chocolate (DC) was introduced into the human diet in South America at least 3,000 years ago and was
37 brought to Europe by Christopher Columbus. ⁽¹⁾ By the end of sixteenth century, the first cacao trees were
38 brought to Spain and were referred as *Theobroma cacao* by Carl Linnaeus in 1753 [4,5]. Later, the chocolate
39 reached Britain and appeared at distinguished chocolate houses then spread in the rest of Europe where many
40 nations started their own plantations of cocoa [6] During the past eras, dark chocolate was the only form
41 available for chocolate in ancient Mesoamerica which is Mexico nowadays.

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43 Dark chocolate is also known as black chocolate or plain chocolate, which is made typically by the addition of
44 fat and sugar to cocoa that is produced from the seeds of the tropical tree *Theobroma cacao* by combining the
45 Greek terms “theo” (meaning God) and “broma” (meaning drink) [7,8] Usually, no milk or less milk is used in
46 this process.

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48 The main aim of the study is to find out the knowledge and attitude towards label claim of dark chocolates
49 available in Oman.

Comment [H2]: Maybe it is not sufficient. I suggest include as purposetowards label claim of dark chocolates **in relation of health benefits**.....

51 2. Materials and Methods

52 2.1 Cross sectional study

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54 The study was conducted from spring 2020 to Fall 2022 in Muscat, Oman and the data was collected from 20
55 October 2020 to 15 November 2020. There are two types of survey were done, one was on products available in
56 Oman market as it was done to compare between the different brands according to the price, ingredient, expiry
57 date, and country of origin. All different brands of dark chocolates were purchased from three hypermarkets of
58 Muscat. The other survey was community based to check their knowledge about dark chocolate benefits. This
59 survey is cross sectional based and was done in Oman focusing on health benefits upon consuming dark
60 chocolate., distributed online in a Google Form. The responses of the survey represented different group of
61 adults. There were 345 responses who participated in filling the survey. Google form questionnaire consisted of
62 21 questions in two languages English and Arabic included in four parts. The first part was on Demographic
63 Data covering name, gender, age, nationality and qualifications. The second part was on knowledge based. The
64 third part was on attitude and last one was practice based. There were 10 participants who were excluded as
65 they answered questions number 20 with NO then they answer the question 21 which is only for people who
66 marked **yes** as an answer. The data collected was then statistically analyzed through MS-Excel. This program
67 was utilized in calculating the percentage from the obtained data and then represent these percentage in charts
68 and tables.

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70 2.2 Study design

- 71 • **Duration:** April 2020 till December 2020.
- 72 • **Place:** Muscat, Oman.
- 73 • **Type:** cross-section survey.
- 74 • **Targeted population:** young Omani adults.

75 • *Data:* Google form (questionnaire).

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77 3. RESULTS AND DISCUSSION

78 3.1 Data Collection

79 The current research survey presented Dark Chocolate and Health Related Quality of Life in Muscat, Oman.
80 After collecting the data, we started studying the numbers and analyzing them, where we divided the questions
81 into four parts each part serves a common topic as mentioned previously. The first four questions were
82 addressing the demographic characteristics of the respondents. Regarding the gender, we predicted that
83 females would consume more dark chocolate, and yet the results showed that 64% of the respondents were
84 females. The next question was asking about the age group, 63.2% were between 15 to 25 years' old which
85 basically proves that we targeted young adults by sending the survey via national university emails. Less
86 participants were above the age of 45 (3.8% only) which reflects the fact that older people do not have the
87 same level of internet access as younger adults. Moving to the participants Qualification level, 48.98% of them
88 are having baccalaureate degree, 37.68% having diploma degree, 10.14% are undergraduate, 2.61% having
89 master's degree and 0.58% having doctorate degree. The last demographic detail that was about the nationality
90 of the respondent, out of the 345 respondents, 284 were Omani while 61 were non-Omani living in Oman.

91 **Table (1)**Results obtained for Demographic details

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Table (1)			
Demographic characteristic	Options	Number of respondents	Percentage
Gender	Male	123	36%
	Female	222	64%
Age group	15-25	218	63.2%

	25-35	83	24.1%
	35-45	31	8.99%
Table (2)			
Nationality	Omani	284	82.32%
	Non- Omani	61	17.68%
Educational level	Undergraduate	35	10.14%
	Diploma	130	37.68%
	Baccalaureate	169	48.98%
	Master	9	2.61%
	Doctorate	2	0.58%

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3.2 Knowledge based study

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The second section of the survey measured and assessed the amount of respondents' knowledge of dark chocolate ingredients and its effect on health. The study showed that most of the people living in Oman (60%) are considering dark chocolate as a healthy snack, less participants (4.35%) considering

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white chocolate as a healthy snack, but most of them (51.88%) don't know the contents of the dark

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chocolate. 93.33% of the respondents know that cocoa is the major ingredient of dark chocolate and less participants (2.03%) think that fat is the major ingredient of dark chocolate. Approximately

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half of the respondents (50.72%) don't know the effect of the dark chocolate ingredients on health. 50.34%

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of the respondents believe that dark chocolate has cardiovascular effect, reducing blood sugar and reducing menstrual pain and less participants (8.99%) think it has effect on reducing menstrual pain only. The report

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showed that more than half (55.1%) of the respondents don't believe the presence of metals (Cadmium and lead) in dark chocolate is harmful to the body.

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109 **Table (2)**Results obtained for Knowledge Based Questions

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Knowledge-Based Questions	Options	Number of respondents	Percentage
What type of chocolate do you consider as a healthy snack?	White chocolate	15	4%
	Dark chocolate	204	60%
	Milk chocolate	124	36%
Do you know the contents of the dark chocolate?	Yes	162	46.96%
	No	179	51.88%
What is the major ingredient of dark chocolate?	Cocoa (cacao)	322	93.33%
	Fat	7	2.03%
	Sugar	14	4.06%
Do you know effect of the ingredients on health?	Yes	162	48%
	No	175	52%
Do you think the presence of metals (Cadmium and lead) in dark chocolate is harmful to your body?	Yes	153	44.35%
	No	190	55.1%
Which of the following effects does dark chocolate have?	Cardiovascular effect	104	30.14%
	Blood sugar reduction	50	14.49%
	Reducing menstrual pain	31	8.99%
	All of above	174	50.43%

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115 3.3 Attitude based study

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117 Moving to third part of our survey that measured and assessed of the respondents' attitude and preference regarding

118 of dark chocolate. The study clearly showed that respondents looking for ingredients before buying as more than

119 half (60%) of the respondents say it is important to know the ingredients of dark chocolate before buying it. Sugar

120 (41.45%) is the highest ingredients that respondents looking for while 32.75% of the respondents are looking for the

121 cocoa percentage and less are looking for other ingredients (cholesterol/fat, sodium, protein and others). Only

122 26.96% of the respondents are looking for all ingredients that mentioned above. Moving on to the aspects that

123 respondents look for while buying dark chocolate which are expiry date, brand, packaging, country of origin and

124 price.

125 36.23% of our respondents are looking for all aspects that mentioned above while 35.65%, 32.46% and 29.86% are

126 looking for expiry date, price and brand respectively. Less respondents looking for packaging (11.3%) and country

127 of origin (21.16%). Next questions we discussed about the additives to the dark chocolate which are antioxidant,

128 preservatives, flavor enhancer, sweetener, coloring agents and others. The results that we got is that more than half

129 (70%) of the respondents know it is necessary to check the type of additives in dark chocolate. 15%, 14%, 14%,

130 13%, 8% and 14% check for antioxidant, preservatives, flavor enhancer, sweetener, coloring agents and other

131 additives respectively. In addition, 22% of the respondents cannot differentiate between the additives. Last question

132 we discussed in this part is the decoration that respondents like on the chocolate which are icing, sprinkles and

133 chocolate sauce. 47.54% of the respondents don't prefer any decoration in their chocolate while 29.57%, 15.1% and

134 6.7% prefer chocolate sauce, icing and sprinkles respectively.

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136 **Table (3)** Results obtained for Attitude Based Questions

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Table (3)			
Attitude Based Questions	Options	Number of respondents	Percentage
Is it important to know the	Yes	203	60%

ingredients before buying dark chocolate?	No	138	40%
What is the ingredient that you look for before buying?	Cocoa percentage	113	32.75%
	Cholesterol/fat	79	22.98%
	Sodium	14	4.06%
	Protein	44	12.75%
	Sugar	143	41.45%
	All of above	93	26.96%
	Any other	10	2.89%
Which aspect do you look for while buying dark chocolate?	Expiry date	123	35.65%
	Brand	103	29.86%
	Packaging	39	11.3%
	Country of origin	73	21.16%
	Price	112	32.46%
	All of above	125	36.23%
Is it necessary to check the type of additives in dark chocolate?	Yes	237	70%
	No	103	30%
In your opinion, which of the following additives are ok to be present in dark chocolate?	Antioxidant	67	15%
	Preservatives	63	14%
	Flavor enhancer	64	14%
	Sweetener	61	13%
	Coloring agents	38	8%
	None of them	67	14%
	I cannot differentiate	104	22%
What decoration would you like	Icing	52	15.07%

on your chocolate?	Sprinkles	23	6.67%
	Chocolate sauce	102	29.57%
	None	164	47.54%

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139 *3.4 Practice based study*

140 The last part of our study we measured and assessed of the respondents' practice routine and preference in
 141 purchasing of dark chocolate. We found only 9% of the respondents who buy dark chocolate always and 35% rarely
 142 buy it. More than half (69.28 %) of the respondents consume dark chocolate once in a week. We discussed the
 143 different reasons for eating dark chocolate. People could be eating dark chocolate when they are in happy or sad,
 144 stress, in bad mood, having PMT and hungry. The results which we got is that 68.12% more than half of the
 145 respondents eat dark chocolate for no specific reason and 10.14%, 9.57%, 8.99%, 8.12%, 6.38% and 5.51% eating
 146 dark chocolate when they are hungry, in a bad mood, in a happy mood, sad, have PMT and stressed respectively.
 147 Also, we found 51% of the respondents who consumption of chocolate remain same around the period time, 39%
 148 double consumption of chocolate and less percentage 10% triple consumption of chocolate. Moreover 71.88 % of
 149 the respondents recommend the consumption of dark chocolate to their friends and family by advising them that
 150 dark chocolate is good for stress suppression, for losing weight when you are in diet, to enhancing the memory
 151 (brain function) and to have healthy skin. The most brand found to be consumed is Galaxy 49.28% because it is the
 152 cheapest among the other brands and least brand found to be consumed is Godiva 4.64% which is the most
 153 expensive one. The last part in this section of our study we discussed the flavor preference, we found that
 154 approximately half (51.6%) of the respondents do not prefer dark chocolate with flavors and 48.41% who prefer
 155 dark chocolate with flavors. The most favorite flavor is the nuts which corresponding to 60% of the respondents and
 156 the least favorite flavor is chili pepper which corresponding to 3%.

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162 **Table (4)**Results obtained for Practice Based Questions

Table (4)			
Practice Based Questions	Options	Number of respondents	Percentage
How frequently do you buy dark chocolate?	Always	30	9%
	Often	59	17%
	Sometimes	134	39%
	Rarely	119	35%
How many times in a week do you consume dark chocolate?	Once	239	69.28%
	Twice	46	13.33%
	Three times	23	6.67%
	More	22	6.38%
What are/is the reason/s for eating dark chocolate? I eat dark chocolate	When you are happy	31	8.99%
	When you are sad	28	8.12%
	When you are stressed	19	5.51%
	When you are in a bad mood	33	9.57%
	When you have PMT	22	6.38%
	When you are hungry	35	10.14%
	No specific reason	235	68.12%
Do you double your chocolate consumption around your period time?	Yes	98	39%
	I triple it	26	10%
	No	127	51%
Do you recommend the consumption of dark chocolate to your friends	Yes	248	71.89%
	No	86	24.93%

and family?			
What is the advice you give to others while recommending eating dark chocolate? It is good for	Stress suppression	98	28.41%
	Losing weight	56	16.23%
	Enhancing the memory (brain function)	92	26.67%
	Skin	32	9.28%
	Others	137	39.71%
Which of the following brands do you consume the most?	Lindt	26	7.54%
	Hersheys	43	12.46%
	Galaxy	170	49.28%
	Godiva	16	4.64%
	Others	81	23.48%
Do you prefer dark chocolate with flavors?	Yes	167	48.41%
	No	178	51.59%
If yes, which flavor do you prefer the most?	Mint	11	6%
	Chili pepper	5	3%
	Orange	13	8%
	Nuts	100	60%
	Others	38	23%

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165 We found that many consume dark chocolate to reduce menstrual pain also many who double and triple that

166 consuming of dark chocolate and that proffs what we found in article (Dark chocolate's effect on menstrual pain in

167 late adolescents)[9] which is done on 2017 Dec 28 by Maharani SI, Pramono N and Wahyuni S. in this study they

168 show that dark chocolate has a significant effect in reducing menstrual pain in the late adolescents. We found

169 28.41% of our participants consume dark chocolate to suppress stress, 9.28% for skin benefits, 26.67% for

170 enhancing the memory (brain function) and 16.23% for losing weight that proof what we found in the literatures

171 (Dark chocolate: Consumption for pleasure or therapy?[10] which is done on 2009 Nov by Lippi G, Franchini M,








Comment [H3]: These results are not previously presented in a table or figure. And also is not included as part of the purpose of the study. It is recommended include the health benefits in the objective/purpose and also should be showed in a separate table or figure.

172 Montagnana M, Favaloro EJ, Guidi GC and Targher G, Health benefits of dark chocolate^[11] which is done on 2014
 173 by Haritha K, Kalyani L and Rao AL, Effect of the dark chocolate consumption on some markers of oxidative stress,
 174 endothelial dysfunction and inflammation of a healthy population⁽¹⁸⁾ which is done on 2017 by Lares M and Pérez
 175 E.) Which are talking about dark chocolate effects on health but majority of our study 39.71% consume dark
 176 chocolate for pleasure and they don't know about the benefits. Also we found that label information has an huge
 177 impact on the consumers as 36.23% of our study they look for all aspect of label information while buying dark so
 178 different packaging labels affect consumers purchase intention of dark chocolate, the results is same to the
 179 study Influence of label information on dark chocolate acceptability [12]. which is done on 2012 Apr by Torres-
 180 Moreno M, Tarrega A, Torrescasana E and Blanch C. as they found that various brands of dark chocolate has
 181 influence on consumers' expectations.

182 3.5 Product survey

183 **Table 5** represents the various brands that have a separate line for dark chocolate production. This table is a brief
 184 description on each brand regarding its ingredient, price, country of origin, production and expiry dates. Each brand
 185 of these offers a variety of dark chocolate in term of cocoa solid percentage such as Lindt which provides 65%,
 186 70%, 85%, 90% and 95% of cocoa to the consumers along with variety in flavors such as mint, orange, chili, etc.

18

Product survey of main dark chocolate brands available in Oman						
Brand name	Image	Country of origin	Ingredients	Price	Production and Expiry dates	
188 Godiva		Belgium	Cocoa mass, sugar, cocoa butter, cocoa powder, emulsifier (soy lecithin), salt, butter oil (milk), coca solids 72%.	1.210 OMR	PD:29/4/2021	ED:29/10/2022
189 Lindt		Switzerland	Cocoa mass, fat reduced cocoa, cocoa butter, demerara sugar, coca solids 99%.	1.130 OMR	PD:22/1/2021	ED:23/4/2022
190 Galaxy		China	Cocoa mass, sugar, milk fat, cocoa butter, non hydrogenated vegetable fat (less than 5 % of palm oil), emulsifier (soy lecithin E 322), natural flavoring (vanillas, citrus), artificial flavor (methyl vanillin), cocoa solid 35% minimum.	0.280 OMR	PD:04/03/2021	ED:02/03/2022
191 Guylian		Belgium	Cocoa mass, dietary fiber (dextrin, inulin, oligofructose), cocoa butter, sweetener (erythritol), fat reduced cocoa powder, emulsifier (sunflower lecithin), coca solids 84%.	1.313 OMR	PD:22/4/2021	ED:20/10/2022
192 Schogetten		Germany	Cocoa mass, cocoa butter, cocoa powder, emulsifier (lecithin), butter oil (milk), coca solids 60%.	0.473 OMR	PD:17/2/2021	ED:30/9/2022
193 Whittaker's		New Zealand	Cocoa mass, pure coca butter, sugar, emulsifier (soy lecithin), natural vanilla flavor, coca solids 92%.	1.460 OMR	PD:20/8/2020	ED:20/12/2021
194 Mackie's		Scotland	Cocoa mass, cocoa butter, cocoa powder, emulsifier (lecithin), mint flavor, coca solids 60%.	0.930 OMR	ED:30/9/2021	

196

197 As mentioned above, many participants expressed their knowledge of the health aspect of dark chocolate and their
198 interest in choosing the best product by examining the ingredients - especially the cocoa percentage- of the product
199 before purchasing. According to the participants' responds mentioned previously, Galaxy is the brand most preferred
200 and consumed (49.28%) in the Omani market. Admittedly, people tend to buy dark chocolate, which has lower
201 levels of fat and sugar. This indicates the high level of people's acceptance of dark chocolate despite its bitter taste.

202 Table 5 gives a description of the ingredients of dark chocolate for each brand mentioned. It is worth noting that
203 despite the fact that the Galaxy brand is the most consumed, it contains only 35-79% cocoa. It is noted that Lindt
204 and Whitaker's brands have the highest cocoa solids content compared to the other mentioned brands, as they
205 contain 99 % and 92 % cocoa respectively. Guylian brand then comes after these two brands, as it contains 84%
206 cocoa solids.

207
208 It should be added that although people tend to consume chocolate that contains a lower level of sugar, it should be
209 noted that dark chocolate contains the lowest sugar content compared to other types of chocolate. Here in table 5,
210 due to the lack of specific percentages of sugar levels in these brands, the comparison is difficult from this direction,
211 but it should be noted that the darker the chocolate is in color, the lower the amount of sugar it contains.

212 Table 5 also states that the majority of the mentioned brands contain emulsifiers, as it prevents cocoa and cocoa
213 butter from separating and helps to blend the flavors. In Table 5, it is found that lecithin, which is from a natural
214 source, is the most widely used emulsifier and stabilizer. It was also stated that many brand of dark chocolate
215 contain flavors such as mint flavor, natural vanilla flavor, citrus. In addition, it is important to state that some dark
216 chocolate brands contain some additives. Here in table 5, Guylian brand contains erythritol which is an artificial
217 sweetener, antioxidant, and excipient and flavoring agent.

218 Dark chocolate is famous for its bittersweet taste and for being a rich source of several minerals and antioxidants. In
219 the early days, chocolate was subjected to a lot of criticism for containing a large amount of fat and it is worth
220 noting that consuming chocolate was not considered a remedy at that time, but rather it was considered a sin. Its
221 consumption was associated with several cases of caries, acne, hypertension, diabetes and obesity. However, the
222 discovery of the biological content of dark chocolate has changed this perception and has encouraged many
223 researches related to the potential health benefits of dark chocolate.

224

225 The questionnaire, in which 345 people participated, proved that many people are now aware of the health benefits
226 of dark chocolate. Many participants expressed their knowledge of the health aspect of dark chocolate and their
227 interest in choosing the best product by examining the ingredients especially the cocoa percentage of the product
228 before purchasing. However, the participants didn't specify which brand of DC they choose, but it is clear that
229 Galaxy is the brand most preferred in the market.

230
231 People tend to buy a dark chocolate containing low levels of fat and sugar. This indicates the high level of people
232 acceptance of the plain dark chocolate, despite it being bitter in taste. Admittedly, it should also be noted that a
233 group of people is still not aware of the health effects of the dark chocolate, which shows the need to spread more
234 awareness related to the benefits of consuming dark chocolate, as they are facts that have been scientifically proven.

235

236 **4. Conclusion**

237

238 Dark chocolate is famous for its bittersweet taste and for being a rich source of several minerals and antioxidants. In
239 the early days, chocolate was subjected to a lot of criticism for containing a large amount of fat and it is worth
240 noting that consuming chocolate was not considered a remedy at that time, but rather it was considered a sin. Its
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254 group of people is still not aware of the health effects of the dark chocolate, which shows the need to spread more
255 awareness related to the benefits of consuming dark chocolate, as they are facts that have been scientifically proven.
256

257 5. Ethical Approval

258
259 The research work was approved by the ethics committee (Reference No-Phar 425-CoP-33) of college of Pharmacy,
260 National university of Science and Technology, Muscat, Oman.
261

262 **COMPETING INTERESTS DISCLAIMER:**

263
264 Authors have declared that no competing interests exist. The products used for this research
265 are commonly and predominantly use products in our area of research and country. There is
266 absolutely no conflict of interest between the authors and producers of the products because we
267 do not intend to use these products as an avenue for any litigation but for the advancement of
268 knowledge. Also, the research was not funded by the producing company rather it was funded
269 by personal efforts of the authors.
270

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UNDR PEER REVIEW

