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Effects of Red Dragon Fruit on Color Stability of Self-Adhesive Flowable Composite

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Keywords: Color stability, red dragon fruit, self-adhesive flowable composite

Abstract. Restorative material is exposed to oral fluid and may have its color stability affected. Oral fluids may be influenced by beverages, such as red dragon fruit juice, which has low pH. The aim of this study is to investigate the effects of red dragon fruit juice on color stability of self-adhesive flowable composite (SAFC). In this study, 50 samples of SAFC discs (diameter = 6mm, height = 3mm) were divided into 5 groups (n=10); sample 1 was control immersed in distilled water for 24 hours, sample 2 was immersed for 8 hours in red dragon fruit juice and 16 hours in distilled water (37ºC) for total 6 days (sample 2A) and for total 12 days (sample 2B), sample 3 was immersed in distilled water for 24 hours in distilled water (37ºC) for total 6 days (sample 3A) and for total 12 days (sample 3B). Color stability was tested using VITA Easy-shade V. The value of color deviation (⊗E), value of lightness (⊗L), value of chrome (⊗C), and value of hue (⊗h). Samples were then categorized to group A by substracting the scores between sample 1 and 2A; group B between sample 1 and 2B; group C between sample 1 and 3A; and group D between sample 1 and 3B. One way ANOVA test showed there was significant differences ($p<0.05$) of ⊗E, ⊗L, ⊗C value, while ⊗h values showed no significant differences ($p\geq0.05$). The difference between group 1 and group 3B has the largest overall color changes with ⊗E 1.01 ± 0.099. Discoloration of self-adhesive flowable composite can be influenced by water sorption, polymerization, composition, immersion time and the type of soaking solution which is red dragon fruit juice and distilled water. This study concluded that red dragon fruit juice as also distilled water affects color stability of SAFC.

Introduction

The use of dental composite resin as material for direct and indirect restorations in both anterior and posterior teeth to replace the hard tissue structures of teeth has increased in recent years [1,2]. Composite resin can resemble teeth, such as having good aesthetics as restorative materials with tooth like color [3,4]. Composite resin, based on the percentage of filler load can be divided into packable and flowable [4]. Flowable resin composite is a conventional composite with a filler reduction of 37% - 53% compared to packable composite resin which has a filler volume of 50% - 70%. The reduction in filler volume modifies the viscosity of the resin composite to a lower level, so it will be much easier to use on a small preparation that are difficult to reach with a conventional composite resin [5].

The adhesion of the composite resin to the teeth requires an adhesive or bonding material that acts as a link between teeth which is hydrophilic and composite resin which is hydrophobic [6]. One of the factors that caused the increasing usage of resin composite is due to many developments such as simplification in adhesive and bonding materials [7]. The invention of self-adhesive flowable composite (SAFC), as the 8th generation of dental adhesive materials, which combines resin composite technology with adhesive materials, so that in one package there is a bonding materials and resin which simplify and accelerate the application of restorative materials [8,9]. SAFC is easy to use as it does not require separate etching, primer, and adhesive applications. Other advantages of SAFC, it can reduce procedural errors because it is easier to use, so that the application time is shorter

[3,10]. SAFC itself is indicated for small cavities, as pit and fissure sealant, orthodontic bracket bonding material, repair of porcelain materials, etc [11].

In an oral environment, restorative materials exposed and interacts to oral fluids, which can cause discoloration of the restorative materials, intrinsically and extrinsically [12,13]. The intrinsic factors involving resin composite composition, matrix, filler, inadequate polymerization of matrix, that caused discoloration. The second factor is extrinsic factor, which can be caused by plaque accumulation, intensity and duration of composite resin light polymerization, the influence of environmental factors in an oral environment such as oral temperature, water absorption and adsorption of colored food and drinks [12,13]. Food coloring is divided into two, artificial food coloring such as soft drinks and syrups, then for natural food coloring such as fruit juices, coffee and tea [12]. Research by Barglar et al [14] shows that composite resin can change color when it is exposed with colored food and beverages.

Nowadays, consuming healthy drinks such as fresh fruit juices is becoming a trend [15]. One of the fruits that is often consumed is red dragon fruit (*Hylocereus polyrhizus*), which has a lot of benefits for the body, such as increasing metabolic process because it is rich of vitamin C and minerals [16]. Red dragon fruit itself is relatively high produced in Indonesia, such as in West Java, South Sulawesi, Batam, and others [17]. Beverages that come from fruit tend to have high acidity. Acidic beverages can reduce mechanical strength of restorative materials, and it can increase water absorption of restorative materials. Mangiri et al reported that red dragon fruit contains natural fruit coloring, that is able to color dental plaque because it contains color pigment betacyanin (reddish purple) and anthocyanin (yellow) [17], but there was no study regarding to the color stability of dental composites. Therefore, the purpose of this study was to investigate the effects of red dragon fruit juice on color stability of self-adhesive flowable composite.

Materials and Methods

This research is a laboratory experimental, which conducted in Dental Material and Testing Center of Research (DMT Core), Faculty of Dentistry, Universitas Trisakti. A total of 50 self-adhesive flowable composite's disc samples were prepared with Dyad Flow (Kerr Dental, Lot #7288946). These samples are 6 mm in diameter and 3 mm in height (± 0,1 mm) according to American Dental Association (ADA) specification No. 27, which has a smooth surface and without porosity [18].

SAFC samples were made by slowly inserting the composite resin into the mold, were covered by celluloid strip and trimmed using plastic filling. The samples were polymerized using light curing unit for 20 seconds, according to product instructions. After composites hardens, samples were removed from the mold and measured using a digital caliper. For the soaking solution, 500 g of red dragon fruit is cleaned and cut, then blended for 20 – 30 seconds for 310 mL of 100% fresh red dragon fruit juice. Then the juice was poured into the container, and pH of the solution was measured by a pH meter every day. In this study, samples were divided into 5 groups (n=10). Sample 1 was control. Sample 2A was submerged in red dragon fruit juice for 8 hours/day inside of an incubator (37^{o}C) and continued in distilled water for 16 hours in distilled water (37^{o}C) in total of 6 days, and sample 2B for 12 days. Sample 3 was submerged in distilled water for 24 hours/day in the in incubator (37^{o}C), which is divided into 2 subsamples according time, sample 3A was submerged for 6 days and 3B for 12 days.

All of the solutions were replaced every day. Color measurements were carried out after immersion on the 6^{th} and 12^{th} days. Prior to observation, samples 2A and 2B were rinse using distilled water and dried on tissue paper. Color stability was tested with VITA Easy-shade V with a black background, and the results were recorded. The results of the VITA Easy-shade V device show overall color deviation (E), lightness or value (L), chrome (C) and hue (h). This research uses value of E (⊗E), value of L (⊗L), value of C (⊗C), and value of h (⊗h), that were obtained from subtracting the scores for samples number 2 (2A and 2B) and samples number 3 (3A and 3B) against the control sample (sample 1). The result of subtracting the scores were named Group A, B, C, and D. Group A is the difference between sample 1 and sample 2A; group B is the difference between sample 1 and sample

2B; group C is the difference between sample 1 and sample 3A; Group D is the difference between sample 1 and sample 3B. Statistical analysis was performed with one way ANOVA and post hoc Tukey test using SPSS software version 23.

Results and Discussion

The color was tested using VITA Easy-shade V. The data were the results from changes in the value of E (⊗E), value of L (⊗L), value of C (⊗C), and value of h (⊗h). The results are shown in Table 1.

Table 1. Mean value of ⊗E, ⊗L, ⊗C, and ⊗h

Group	Mean Value			
	⊗E	⊗L	⊗C	⊗h
Group A	0.33 ± 0.094^{a}	0.39 ± 0.099^{c}	0.01 ± 0.237^{e}	-0.26 ± 0.316^{g}
Group B	0.46 ± 0.206^{a}	0.57 ± 0.294^{c}	$0.27 \pm 0.216^{e,f}$	-0.39 ± 0.299^{g}
Group C	0.39 ± 0.110^{a}	0.47 ± 0.133^{c}	$0.09 \pm 0.202^{e,f}$	-0.09 ± 0.272^{g}
Group D	1.01 ± 0.099^{b}	1.30 ± 0.182^{d}	0.29 ± 0.268^{f}	-0.24 ± 0.374^{g}

*Same small alphabet shows no significant difference (ANOVA and post hoc Tukey test, $p \geq 0.05$) among the values in the same column. Group A = the difference between sample 1 and sample 2A; Group B = the difference between sample 1 and sample 2B; Group C = the difference between sample 1 and sample 3A; Group D = the difference between sample 1 and sample 3B

This research carried out the normality test with Shapiro-Wilk method ($n < 50$) before statistical test using one-way ANOVA. All values of △E, △L, △C, and △h show $p > 0.05$, so that the research data is normally distributed. Then the data were analyzed using the one-way ANOVA. There are significant differences among groups ($p < 0.05$) in ΔE ($p = 0.000$), ΔL ($p = 0.000$), and ΔC ($p = 0.026$), while Δh ($p = 0.233$) shows $p > 0.05$, which means there is no significant difference among groups. Post hoc Tukey test results for the difference among ΔE, ΔL, and ΔC values are mentioned in Table 1.

In this research, discoloration is not visible with naked eyes. Therefore, the measurement of discoloration was carried out using the VITA Easy-shade V spectrophotometer with the results of E, L, C and h. To assess the color change, ΔE, ΔL, ΔC, and Δh was calculated. The values of ΔE, ΔL, and ΔC are significantly different, while there are no significant differences in Δh. The values of L represent the level of brightness, so the more positive the ΔL value shows the lighter of the SAFC color. In this research, the highest ΔL value was group D or the difference between group 3B (group that submerged in distilled water for 12 days) and the control group. The value of C represents intensity level of a color, so that the more positive the ΔC value, the darker the SAFC color will be. In this research, the value of ΔC in group D shows the highest average score compared to other groups. This indicates that SAFC immersed in distilled water for 12 days experienced a more concentrated color change. Both of time and type of immersion caused significant color change. The value of h represents color degree, so that the more negative the Δh value, the redder it is, while the more positive it is, the yellower the SAFC color will be. The highest Δh value indicated by group B which represents the difference between group 2B (group that submerged in red dragon fruit juice for 12 days) and control group. The results shows that all Δh values are negative, it means the immersion in red dragon fruit juice for 12 days caused the highest color changes to become redder. This can be caused by the red pigment content of betacyanin [20] in red dragon fruit which is absorbed with water. The value of ΔE is the amount of color change that occurs, so that the greater the ΔE value, the greater the color change that occurs. The highest ΔE value is group D (the difference between group B and control group), which means in group D shows the largest overall color change.

Discoloration occurred can be influenced by several factors, such as water sorption factors. Water sorption can occur due to the size of the water molecules that are smaller than the distance of the two polymer chains, namely 0.16 nm, thus making it easier for water to enter the composite through a monomer mechanism which is hydrophilic and causes degradation which makes the matrix and filler bonds unstable [21-23]. Water molecules that are absorbed into the polymer chain will fill the micro gaps due to the expansion of the polymer chain [24, 25]. The value of ΔE that is greater in SAFC immersed in distilled water may be influenced by the higher viscosity of red dragon fruit juice to the viscosity of distilled water. The larger the molecular size, the higher the viscosity of the solution [26,27]. Red dragon fruit juice has higher viscosity and bigger molecule size than water. Therefore, it is more difficult for red dragon fruit juice molecules to be absorbed and enter the polymer chain.

Second factor that can cause discoloration is polymerization. Polymerization in SAFC occurs during and after light cured, but complete polymerization has not be achieved after light curing, because it only 55–65% of the monomer is polymerized [28]. Polymerization still continues even though the light curing process has been completed [29-30]. During polymerization, the monomers in the composite bind each other to form a polymer, and there are non-polymerized monomers which later will form cross-linking [28-31]. According to Karaarslan et al [32] and Celik et al [33], after polymerization there is a color change in the composite. The color of the composite resin changes to a lighter or translucent color after radiation by light [34]. This is consistent with this research, the L value in SAFC increased or became brighter after the immersion. However, it is different from the C value of this research, which is getting thicker after the immersion.

The third factor is the SAFC composition. SAFC is a flowable composite, which has a lower filler rate of 37–50% compared to packable composites [5]. Previous research showed composites with fewer filler tend to have poorer color stability, because they have a higher number of matrixes, so that the water sorption increased [7]. Micro gaps that occur due to water sorption can cause penetration of the stain, causing discoloration [25].

The other factor is the immersion time. The highest value of ⊗E, ⊗L, and ⊗C is belong to group 3B, SAFC group that was soaked in distilled water for 12 days. On the other hand, the highest ⊗h value is SAFC group that was soaked in red dragon fruit juice for 12 days. Pursuant to Ortengren et al, degradation that caused by water sorption is influenced by the length of time the composite is exposed to water [22]. Therefore, the immersion in red dragon fruit juice or distilled water needs longer time to cause color changes, because it is related to water sorption. Even it is immersed in red dragon fruit juice for 12 days, the color changes is not significantly different. Therefore the longer immersion time study is needed to know the exact time of significant color changes of the SAFC.

The fifth factor that can cause discoloration is the type of soaking solution. In this research, red dragon fruit juice with acidity or pH degree of 4.91 was used and distilled water has pH 7. The pH of red dragon fruit juice which tended to be slightly acidic did not affect the SAFC color change in this research. In contrast to research by Moon et al, which states that there is a relationship between pH and color change even though the change is small [35]. This is because the acidic pH can degrade the dense material so that it forms micro gaps which can affect the absorption of water in the material [36]. Therefore, the result of this study is not in accordance with previous research regarding soaking composites in acidic solutions.

Consumption of red dragon fruit that is not excessive does not cause discoloration and a decrease in SAFC value. Red dragon fruit is a fruit that has a lot of good content for the body, such as being rich in vitamin C and can increase metabolism in the body [16] but education is needed for patients to drink water and brush their teeth after consuming red dragon fruit [37]. It is also suggested that patients could use straw while consuming red dragon fruit juice.

Conclusion

It can be concluded that immersion self-adhesive flowable composite (SAFC) in red dragon fruit juice affects color stability. However, the immersion of SAFC in red dragon fruit juice is not worse than the immersion of SAFC in distilled water.

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Introduction

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The adhesion of the composite resin to the teeth requires an adhesive or bonding material that acts as a link between teeth which is hydrophilic and composite resin which is hydrophobic [6]. One of the factors that caused the increasing usage of resin composite is due to many developments such as simplification in adhesive and bonding materials [7]. The invention of self-adhesive flowable composite (SAFC), as the 8th generation of dental adhesive materials, which combines resin composite technology with adhesive materials, so that in one package there is a bonding materials and resin which simplify and accelerate the application of restorative materials [8,9]. SAFC is easy to use as it does not require separate etching, primer, and adhesive applications. Other advantages of SAFC, it can reduce procedural errors because it is easier to use, so that the application time is shorter

[3,10]. SAFC itself is indicated for small cavities, as pit and fissure sealant, orthodontic bracket bonding material, repair of porcelain materials, etc [11].

In an oral environment, restorative materials exposed and interacts to oral fluids, which can cause discoloration of the restorative materials, intrinsically and extrinsically [12,13]. The intrinsic factors involving resin composite composition, matrix, filler, inadequate polymerization of matrix, that caused discoloration. The second factor is extrinsic factor, which can be caused by plaque accumulation, intensity and duration of composite resin light polymerization, the influence of environmental factors in an oral environment such as oral temperature, water absorption and adsorption of colored food and drinks [12,13]. Food coloring is divided into two, artificial food coloring such as soft drinks and syrups, then for natural food coloring such as fruit juices, coffee and tea [12]. Research by Barglar et al [14] shows that composite resin can change color when it is exposed with colored food and beverages.

Nowadays, consuming healthy drinks such as fresh fruit juices is becoming a trend [15]. One of the fruits that is often consumed is red dragon fruit (*Hylocereus polyrhizus*), which has a lot of benefits for the body, such as increasing metabolic process because it is rich of vitamin C and minerals [16]. Red dragon fruit itself is relatively high produced in Indonesia, such as in West Java, South Sulawesi, Batam, and others [17]. Beverages that come from fruit tend to have high acidity. Acidic beverages can reduce mechanical strength of restorative materials, and it can increase water absorption of restorative materials. Mangiri et al reported that red dragon fruit contains natural fruit coloring, that is able to color dental plaque because it contains color pigment betacyanin (reddish purple) and anthocyanin (yellow) [17], but there was no study regarding to the color stability of dental composites. Therefore, the purpose of this study was to investigate the effects of red dragon fruit juice on color stability of self-adhesive flowable composite.

Materials and Methods

This research is a laboratory experimental, which conducted in Dental Material and Testing Center of Research (DMT Core), Faculty of Dentistry, Universitas Trisakti. A total of 50 self-adhesive flowable composite disc samples were prepared with Dyad Flow (Kerr Dental, Lot #7288946). These samples are 6 mm in diameter and 3 mm in height (± 0,1 mm) according to American Dental Association (ADA) specification No. 27, which has a smooth surface and without porosity [18].

SAFC samples were made by slowly inserting the composite resin into the mold, were covered by celluloid strip and trimmed using plastic filling. The samples were polymerized using light curing unit for 20 seconds, according to product instructions. After composites hardens, samples were removed from the mold and measured using a digital caliper. For the soaking solution, 500 g of red dragon fruit is cleaned and cut, then blended for 20 – 30 seconds for 310 mL of 100% fresh red dragon fruit juice. Then the juice was poured into the container, and pH of the solution was measured by a pH meter every day. In this study, samples were divided into 5 groups (n=10). Sample 1 was control. Sample 2A was submerged in red dragon fruit juice for 8 hours/day inside of an incubator (37°C) and continued in distilled water for 16 hours in distilled water (37°C) in total of 6 days, and sample 2B for 12 days. Sample 3 was submerged in distilled water for 24 hours/day in the in incubator (37°C), which is divided into 2 subsamples according time, sample 3A was submerged for 6 days and 3B for 12 days.

All of the solutions were replaced every day. Color measurements were carried out after immersion on the 6th and 12th days. Prior to observation, samples 2A and 2B were rinse using distilled water and dried on tissue paper. Color stability was tested with VITA Easy-shade V with a black background, and the results were recorded. The results of the VITA Easy-shade V device show overall color deviation (E), lightness or value (L), chrome (C) and hue (h). This research uses value of E (⊗E), value of L (⊗L), value of C (⊗C), and value of h (⊗h), that were obtained from subtracting the scores for samples number 2 (2A and 2B) and samples number 3 (3A and 3B) against the control sample (sample 1). The result of subtracting the scores were named Group A, B, C, and D. Group A is the difference between sample 1 and sample 2A; group B is the difference between sample 1 and sample

2B; group C is the difference between sample 1 and sample 3A; Group D is the difference between sample 1 and sample 3B. Statistical analysis was performed with one way ANOVA and post hoc Tukey test using SPSS software version 23.

Results and Discussion

The color was tested using VITA Easy-shade V. The data were the results from changes in the value of E (⊗E), value of L (⊗L), value of C (⊗C), and value of h (⊗h). The results are shown in Table 1.

Table 1. Mean value of ⊗E, ⊗L, ⊗C, and ⊗h

Group	Mean Value			
	⊗E	⊗L	⊗C	⊗h
Group A	0.33 ± 0.094[a]	0.39 ± 0.099[c]	0.01 ± 0.237[e]	-0.26 ± 0.316[g]
Group B	0.46 ± 0.206[a]	0.57 ± 0.294[c]	0.27 ± 0.216[e,f]	-0.39 ± 0.299[g]
Group C	0.39 ± 0.110[a]	0.47 ± 0.133[c]	0.09 ± 0.202[e,f]	-0.09 ± 0.272[g]
Group D	1.01 ± 0.099[b]	1.30 ± 0.182[d]	0.29 ± 0.268[f]	-0.24 ± 0.374[g]

*Same small alphabet shows no significant difference (ANOVA and post hoc Tukey test, $p \geq 0.05$) among the values in the same column. Group A = the difference between sample 1 and sample 2A; Group B = the difference between sample 1 and sample 2B; Group C = the difference between sample 1 and sample 3A; Group D = the difference between sample 1 and sample 3B

This research carried out the normality test with Shapiro-Wilk method ($n < 50$) before statistical test using one-way ANOVA. All values of ΔE, ΔL, ΔC, and Δh show $p > 0.05$, so that the research data is normally distributed. Then the data were analyzed using the one-way ANOVA. There are significant differences among groups ($p < 0.05$) in ΔE ($p = 0.000$), ΔL ($p = 0.000$), and ΔC ($p = 0.026$), while Δh ($p = 0.233$) shows $p > 0.05$, which means there is no significant difference among groups. Post hoc Tukey test results for the difference among ΔE, ΔL, and ΔC values are mentioned in Table 1.

In this research, discoloration is not visible with naked eyes. Therefore, the measurement of discoloration was carried out using the VITA Easy-shade V spectrophotometer with the results of E, L, C and h. To assess the color change, ΔE, ΔL, ΔC, and Δh was calculated. The values of ΔE, ΔL, and ΔC are significantly different, while there are no significant differences in Δh. The values of L represent the level of brightness, so the more positive the ΔL value shows the lighter of the SAFC color. In this research, the highest ΔL value was group D or the difference between group 3B (group that submerged in distilled water for 12 days) and the control group. The value of C represents intensity level of a color, so that the more positive the ΔC value, the darker the SAFC color will be. In this research, the value of ΔC in group D shows the highest average score compared to other groups. This indicates that SAFC immersed in distilled water for 12 days experienced a more concentrated color change. Both of time and type of immersion caused significant color change. The value of h represents color degree, so that the more negative the Δh value, the redder it is, while the more positive it is, the yellower the SAFC color will be. The highest Δh value indicated by group B which represents the difference between group 2B (group that submerged in red dragon fruit juice for 12 days) and control group. The results shows that all Δh values are negative, it means the immersion in red dragon fruit juice for 12 days caused the highest color changes to become redder. This can be caused by the red pigment content of betacyanin [20] in red dragon fruit which is absorbed with water. The value of ΔE is the amount of color change that occurs, so that the greater the ΔE value, the greater the color change that occurs. The highest ΔE value is group D (the difference between group B and control group), which means in group D shows the largest overall color change.

Discoloration occurred can be influenced by several factors, such as water sorption factors. Water sorption can occur due to the size of the water molecules that are smaller than the distance of the two polymer chains, namely 0.16 nm, thus making it easier for water to enter the composite through a monomer mechanism which is hydrophilic and causes degradation which makes the matrix and filler bonds unstable [21-23]. Water molecules that are absorbed into the polymer chain will fill the micro gaps due to the expansion of the polymer chain [24, 25]. The value of ⊗E that is greater in SAFC immersed in distilled water may be influenced by the higher viscosity of red dragon fruit juice to the viscosity of distilled water. The larger the molecular size, the higher the viscosity of the solution [26,27]. Red dragon fruit juice has higher viscosity and bigger molecule size than water. Therefore, it is more difficult for red dragon fruit juice molecules to be absorbed and enter the polymer chain.

Second factor that can cause discoloration is polymerization. Polymerization in SAFC occurs during and after light cured, but complete polymerization has not be achieved after light curing, because it only 55–65% of the monomer is polymerized [28]. Polymerization still continues even though the light curing process has been completed [29-30]. During polymerization, the monomers in the composite bind each other to form a polymer, and there are non-polymerized monomers which later will form cross-linking [28-31]. According to Karaarslan et al [32] and Celik et al [33], after polymerization there is a color change in the composite. The color of the composite resin changes to a lighter or translucent color after radiation by light [34]. This is consistent with this research, the L value in SAFC increased or became brighter after the immersion. However, it is different from the C value of this research, which is getting thicker after the immersion.

The third factor is the SAFC composition. SAFC is a flowable composite, which has a lower filler rate of 37–50% compared to packable composites [5]. Previous research showed composites with fewer filler tend to have poorer color stability, because they have a higher number of matrixes, so that the water sorption increased [7]. Micro gaps that occur due to water sorption can cause penetration of the stain, causing discoloration [25].

The other factor is the immersion time. The highest value of ⊗E, ⊗L, and ⊗C is belong to group 3B, SAFC group that was soaked in distilled water for 12 days. On the other hand, the highest ⊗h value is SAFC group that was soaked in red dragon fruit juice for 12 days. Pursuant to Ortengren et al, degradation that caused by water sorption is influenced by the length of time the composite is exposed to water [22]. Therefore, the immersion in red dragon fruit juice or distilled water needs longer time to cause color changes, because it is related to water sorption. Even it is immersed in red dragon fruit juice for 12 days, the color changes is not significantly different. Therefore the longer immersion time study is needed to know the exact time of significant color changes of the SAFC.

The fifth factor that can cause discoloration is the type of soaking solution. In this research, red dragon fruit juice with acidity or pH degree of 4.91 was used and distilled water has pH 7. The pH of red dragon fruit juice which tended to be slightly acidic did not affect the SAFC color change in this research. In contrast to research by Moon et al, which states that there is a relationship between pH and color change even though the change is small [35]. This is because the acidic pH can degrade the dense material so that it forms micro gaps which can affect the absorption of water in the material [36]. Therefore, the result of this study is not in accordance with previous research regarding soaking composites in acidic solutions.

Consumption of red dragon fruit that is not excessive does not cause discoloration and a decrease in SAFC value. Red dragon fruit is a fruit that has a lot of good content for the body, such as being rich in vitamin C and can increase metabolism in the body [16] but education is needed for patients to drink water and brush their teeth after consuming red dragon fruit [37]. It is also suggested that patients could use straw while consuming red dragon fruit juice.

Conclusion

It can be concluded that immersion self-adhesive flowable composite (SAFC) in red dragon fruit juice affects color stability. However, the immersion of SAFC in red dragon fruit juice is not worse than the immersion of SAFC in distilled water.

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