Preparation of Harmless Play Dough with Some Vegetable Dyes

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1. Introduction

Toys are defined as anything that can be played and enjoyed in dictionaries [1]. Toy, which improves the imagination and creative abilities of the child during the stages of development, bringing order to the movements of the child, helping the mental, physical and psycho-social development [2].

For the pre-school children toys play a role that allow them to reflect their world in a pure and simple way. In this sense, games such as hawks and legs are more likely to support children in acquiring skills in different fields [3].

Today, toys are very diverse. They can be made of different materials, different colors and different properties. But the best toy is the toy that the child will want to play again and again and every time it gives him more games and more fun. The toy should raise curiosity in the child, run the muscles, and direct the child to solve the problem [4, 5].

While playing with the toy, it can often face various hazards, especially health problems, by taking the toy to the mouth. For this reason, the materials that are produced and the paint used become even more important in terms of health. Dyes are used to obtain a different color of materials, to obtain aesthetic images [6].

The earliest known story of production of hawks in literature was started in 1955. Inventors N.W. McVicker is Joe McVicker (1929-1992). The product is one of the most popular toys; on the one hand, one of the most interesting inventions [7]. Play-Doh, a game hood for children, 95 million boxes sold in 75 countries, was first produced for wallpaper cleaning. Play-Doh is a modeling material that young children use at home and at school in their handicrafts or artwork [8]. Joe McVicker and N.W. On May 17, 1960, they took the patent of Play-Doh’s last formula.

In this study, we aimed to prepare the harmless play dough using some vegetable extracts. For this purpose, we used wheat flour, some vegetable extracts and auxiliary materials such as clay and tragacanth. As a result, we obtained harmless play dough for children.

2. Experimental Methods

2.1 Materials

Experimental studies were carried out in the Tokat Gaziosmanpasa University, Natural Dyes Application and Research Center laboratory (Tokat-Turkey).

In this work, heat-resistant container for extraction, soxlet device, solid fruit juice for working with cold pressing method, Marshall 1001 Color Hopper for color codes, digital pH meter for measuring the pH value of the environment, a steel cup for mixing dough, suitable for measurement, storage bin, beaker in various dimensions and beakers, analytically sensitive scale, thermostat heater, color measurement spectrophotometer, scale adjustable refrigerator for the storage of samples in appropriate temperature environment, plants were used. White-yellow clay, rose water, vegetables and fruits were supplied from the markets established in Tokat city center. Wheat flour, salt, liquid vegetable oil, dry and wet yeast, grape juice, lemon juice and carbonate were taken from markets.

2.1.1 Properties of Used Materials

Lemon water: Kavaklıdere brand lemon juice is used.
Turkish coffee: Gold Reyan Turkish coffee is used.
Liquid vegetable Oil: Cooperative refined sunflower oil is used.
Processed wheat flour: Birsan flour was used.
Wet yeast: Paskaya brand yeast was used.
Dry yeast: Paskaya brand active dry pasta is used.
Grape circle: Doganay brand grape circle is used.
Sample box: A sample volume of 100 ml volume of Firatmed brand was used.
Rose water: Waterfall brand non-alcoholic rose water is used.
Carbonate: Dr. Oetker brand carbonate is used.
Reference Play dough: Play-Doh brand 4-player game hamper is used.
Cooking salt: Biller salt brand cooking salt is used in fine salt.
Kneading boiler: A steel vessel is used for sterility.
Marshall 1001 color hopper: Used in the color coding phase

2.2 Method

2.2.1 Obtaining of the Play Dough

The methods of thermal heat treatment and clay application are taken from sites that take advantage of organic production and consumption [9]. The other 5 methods have original formulations.
2.3 Preparation of Materials

a) Preparation of Walnut Leaf Extract: 250 g of Walnut leaf were boiled in 2 L of pure water for 1 hour. The obtained extract was used as a dye solution for coloring.

b) Preparation of Pomegranate Extract: 100 g of pomegranate flower was boiled in 1 L of pure water for 1 hour. The obtained extract was used as a dye solution for coloring.

c) Preparation of Turmeric Extract: 10 g of Turmeric powder was extracted in soxhlet device with 4 separate cartridges until the solution of 2 L was obtained with distilled water until colorlessness at boiling temperature. The obtained extract was used as a dye solution for coloring.

d) Preparation of Red Beet Extract: 3 kg of Red beet was boiled in 3 L of pure water for 1 hour. The obtained extract was used as a dye solution for coloring.

e) Preparation of Red Cabbage Extract: 1 kg of grated Red cabbage in 2 L purified water was boiled for 1 hour. The obtained extract was used as a dye solution for coloring.

f) Preparation of the Spinach Extract: The spinach juice obtained by pressing 2 kg of the spinach cold pressing method was heated for 15 minutes and used as a paint solution.

g) Preparation of Indigo Extract: 10 g of powdered cvitus was extracted with distilled water and 30 mL of vegetable oil were extracted until a 3 L solution was obtained at the boiling temperature until colorless. The obtained extract was used as a dye solution for coloring.

h) Preparation of Purple Reed Extract: 10 g of Purple red was extracted in distilled water in soxhlet device. Extraction was continued until 2 L solution until colorlessness. The obtained extract was used as a dye solution for coloring.

i) Preparation of Coffee Extract: 10 g of coffee was extracted in the soxhlet machine with 4 separate cartridges, until the 2 L solution until the colorlessness. The obtained extract was used as a dye solution.

j) Preparation of Red Pepper Extract: 2 kg grated Red pepper was boiled in 4 L of distilled water for 1 hour. The obtained extract was used as a dye solution for coloring.

k) Preparation of Onion Skin Extract: 50 g of Onion skin was boiled in 3 L of pure water for 1 hour. The obtained extract was used as a dye solution for coloring.

l) Preparation of the Carbonate Solution: 10 g of sodium hydroxide carbonate was dissolved in 1 L of purified water and measured at pH 8.61.

2.4 Painting Methods

a) Heat Treatment: After mixing 60 g of processed white wheat flour, 3 mL of liquid vegetable oil, 10 g of food salt, 3 mL of grape juice, 40 mL of extraction solution in a suitable heat-resistant container was heated at 60 °C for 5 min. The mixture was taken from the container through the heater when it was easy to leave. It was kneaded and left to cool for a homogenous image. It was kept airtight after the cold.

This staining method was used in the same way for 11 plants. For direct dusting of indigo grass and cabbage; 50 g of processed wheat flour, 3 mL of liquid vegetable oil, 10 g of food salt, 3 mL of grape juice, 30 mL of pure, 5 g of indigo or coffee water were mixed in a bowl and then stirred on a heater at 60 °C for 5 minutes. The mixture was taken from the container through the heater when it was easy to leave. It was kneaded and left to cool for a homogenous image. It was kept airtight after the cold. At the end of all applications, 13 different colors of game dough were obtained.

b) Without Heat Treatment: 60 g processed white wheat flour, 2 mL liquid vegetable oil, 10 g meal salt, 30 mL extraction solution was mixed and kneaded with hand. It was left to rest when it was a very hard and not very soft consistency. This painting method uses 11 plants. For direct dusting of indigo grass and cabbage; 50 g processed wheat flour, 3 mL liquid vegetable oil, 10 g food salt, 30 mL pure water and 5 g indigo grass dust or coffee are mixed in a convenient container and knead with hand. It was left to rest when it was a very hard and not very soft consistency. 13 different colors of game dough were obtained.

c) Using Clay: 40 g of processed white wheat flour, 20 g of white-yellow clay, 3 mL of liquid vegetable oil, 10 g food salt, 45 mL of extracting paint solution are mixed in a suitable container and then kneaded by hand. It was left to rest when it was a very hard and not very soft consistency. Finally, it was kept airtight after 10 minutes of rest. This staining method was used identically for 11 plants. For direct dusting of indigo grass and cabbage; 40 g of processed white wheat flour, 20 g of white-yellow clay, 3 mL of liquid vegetable oil, 10 g of food salt, 50 mL of purified water, 5 g of indigo powder or coffee were mixed in a suitable container and then kneaded by hand. It was left to rest when it was a very hard and not very soft consistency. It was kept airtight after 10 minutes of rest. At the end of all applications, 13 different colors of game dough were obtained.

2.5 Color codes

The color codes of play doughs obtained using all methods were made using the Marshall 1001 Color Hopper.

2.6 Color Analysis

The obtained samples were made using D65 light source and 10° measurement angle using SS 6200 spectrophotometer.

2.7 Manual Gluten Review

The reference game Hawthorn sold in the market and heat treatment were applied as 2x10 g separately from the game hawthorn samples obtained by the experiment using dry yeast, wet yeast, and the test. 4.8 mL of 2% NaCl solution was added onto the sample. The mixture is kneaded by slowly adding the washing solution. Care was taken to ensure that the dough particles formed during kneading did not stick to the edge of the cabinet and to the mortar. The obtained dough was kept between the fingers, flattened and then rounded again until the starch was completely removed. The wet gluten was washed under tap water for 2 minutes to completely remove the starch. At the end of the process, only gluten with elastic pasty consistency was obtained from the gypsum obtained by using wet yeast and urea.

2.8 Glutograph (Wet Gluten) Analysis

The glaucoma obtained according to the Manual Gluten Evaluation was waited for 5 minutes and put on the glutograph device. At the end of the measurement, the amounts of the play dough passing and not passing through the two separate disk were determined [10].

2.9 Dry Gluten Analysis

The game clone obtained in the age of gluten weighting was placed in the Glutork brand dry gluten-forming device. After waiting 4 minutes at 200 °C, dry gluten was weighed and the results were recorded [10].

2.10 Texture Analysis

Texture analyses of all the dough samples were carried out by SMS-TA XT device using SMS/Kieffer Dough and Gluten Extensibility Rig by applying the "dough and measure quality" method.

2.11 Allergy Application

The samples of the game clay obtained from all methods were applied by 12 students in Tokat/Turkey American Culture Day Care Center, Kindergarten and Nursery School affiliated to the Ministry of Family and Politics.

3. Results and Discussion

Experimental data (CIE Lab, K/S and Color Codes) belong to play dough are given in using heat treated, unheat treated, clay and fragancih in Tables 1-4 and Figs. 1-4. The color reproduction is in the play dough made with the highest for powdered coffee. The CIE Lab wave length of the play dough obtained with red pepper, turmeric and powdered indigo was different and higher than the others.

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13 different colors of organic game dough were obtained using clay. The pH values before the treatment and CIE Lab, K/S value after the treatment are given in Table 3 and Fig. 3. The play dough with the highest color yield was obtained with powdered coffee. However, the CIE Lab wavelength values are all the same.

Table 3 pH, CIE Lab, K/S and color codes using clay

<table>
<thead>
<tr>
<th>Plant</th>
<th>pH</th>
<th>Color coordinate</th>
<th>K/S</th>
<th>Wavelength</th>
<th>Color code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinach</td>
<td>5.55</td>
<td>60.2656</td>
<td>2.6071</td>
<td>23.495</td>
<td>6.19822</td>
</tr>
<tr>
<td>Purple reed</td>
<td>6.08</td>
<td>54.0807</td>
<td>4.6057</td>
<td>13.392</td>
<td>6.65475</td>
</tr>
<tr>
<td>Red pepper</td>
<td>3.85</td>
<td>60.4451</td>
<td>17.5595</td>
<td>31.164</td>
<td>5.42485</td>
</tr>
<tr>
<td>Turmeric</td>
<td>6.95</td>
<td>68.5295</td>
<td>3.1375</td>
<td>29.194</td>
<td>4.56406</td>
</tr>
<tr>
<td>Red cabbage</td>
<td>4.03</td>
<td>44.3370</td>
<td>4.2491</td>
<td>6.70679</td>
<td>3329</td>
</tr>
<tr>
<td>Coffee</td>
<td>8.24</td>
<td>57.7069</td>
<td>2.8099</td>
<td>14.604</td>
<td>5.68654</td>
</tr>
<tr>
<td>Onion skin</td>
<td>6.22</td>
<td>51.2190</td>
<td>5.4975</td>
<td>11.749</td>
<td>7.34952</td>
</tr>
<tr>
<td>Pomegranate</td>
<td>2.54</td>
<td>34.4697</td>
<td>17.5989</td>
<td>3.4238</td>
<td>2.578</td>
</tr>
<tr>
<td>Walnut leaf</td>
<td>6.7</td>
<td>69.3292</td>
<td>2.7240</td>
<td>21.576</td>
<td>5.259</td>
</tr>
<tr>
<td>Red beet</td>
<td>3.55</td>
<td>44.4910</td>
<td>22.531</td>
<td>0.2939</td>
<td>4.817</td>
</tr>
<tr>
<td>Cofe powder</td>
<td>-43.499</td>
<td>8.2721</td>
<td>18.5754</td>
<td>15.737</td>
<td>360</td>
</tr>
<tr>
<td>Indigo extract</td>
<td>8.21</td>
<td>53.399</td>
<td>-4.7529</td>
<td>-13.866</td>
<td>3.210</td>
</tr>
</tbody>
</table>

Fig. 3 Play dough colors obtained using clay

13 different colors of organic game dough have been obtained using tragacanth. The pH values before the treatment and the CIE Lab, K/S and color code after the treatment are given in Table 4 and Fig. 4. The play dough with the highest color yield was obtained with powdered indigo. The CIE Lab wavelength value is different for powder indigo and it is only the highest value compared to the others.

Table 4 pH, CIE Lab, K/S and color codes using tragacanth

<table>
<thead>
<tr>
<th>Plant</th>
<th>pH</th>
<th>Color coordinate</th>
<th>K/S</th>
<th>Wavelength</th>
<th>Color code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinach</td>
<td>5.55</td>
<td>58.122</td>
<td>1.9310</td>
<td>28.059</td>
<td>5.532</td>
</tr>
<tr>
<td>Purple reed</td>
<td>6.08</td>
<td>66.433</td>
<td>1.8204</td>
<td>12.893</td>
<td>3.801</td>
</tr>
<tr>
<td>Red pepper</td>
<td>3.85</td>
<td>74.415</td>
<td>24.1099</td>
<td>39.727</td>
<td>1.8995</td>
</tr>
<tr>
<td>Turmeric</td>
<td>6.95</td>
<td>83.725</td>
<td>-2.905</td>
<td>33.096</td>
<td>1.7549</td>
</tr>
<tr>
<td>Red cabbage</td>
<td>4.03</td>
<td>59.604</td>
<td>1.7937</td>
<td>6.9998</td>
<td>4.5221</td>
</tr>
<tr>
<td>Coffee</td>
<td>8.24</td>
<td>75.996</td>
<td>3.7867</td>
<td>19.2737</td>
<td>2.7993</td>
</tr>
<tr>
<td>Onion skin</td>
<td>6.22</td>
<td>75.674</td>
<td>4.5168</td>
<td>16.098</td>
<td>2.8511</td>
</tr>
<tr>
<td>Pomegranate</td>
<td>2.54</td>
<td>57.523</td>
<td>5.1089</td>
<td>5.5413</td>
<td>3.8144</td>
</tr>
<tr>
<td>Walnut leaf</td>
<td>6.7</td>
<td>73.700</td>
<td>2.8347</td>
<td>16.198</td>
<td>2.5994</td>
</tr>
<tr>
<td>Red beet</td>
<td>3.55</td>
<td>74.425</td>
<td>4.9333</td>
<td>8.948</td>
<td>1.5381</td>
</tr>
<tr>
<td>Coffee powder</td>
<td>-40.222</td>
<td>9.7239</td>
<td>18.2141</td>
<td>15.517</td>
<td>360</td>
</tr>
<tr>
<td>Indigo extract</td>
<td>8.21</td>
<td>76.253</td>
<td>4.5162</td>
<td>-4.331</td>
<td>0.9459</td>
</tr>
<tr>
<td>Indigo powder</td>
<td>-33.495</td>
<td>6.0341</td>
<td>-32.62</td>
<td>8.8679</td>
<td>590</td>
</tr>
</tbody>
</table>

Fig. 2 Play dough colors obtained without heat treatment

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3.1 Texture Analysis

The texture analysis graph of play dough obtained from without heating is given in Fig. 5.

Fig. 5 Texture analysis graphic of play dough obtained without heat treatment

For the play dough obtained without heat treatment, each color shows the same sample but different pieces. According to the result of the sample, the highest force value required to break the specimen was found to be 14,075 force (g). The distance (mm) was found to be 35.07 mm for the play dough obtained without heat treatment. The texture analysis of play dough obtained from by heat treatment are given in Fig. 6.

Fig. 6 Texture analysis graphic of the play dough obtained by heat treatment

For the play dough obtained by heat treatment, each color shows the same sample but different pieces. According to the result of the sample, maximum force value to be applied for breaking of the samples was found to be 24,161 force (g). The distance (mm, the elongation to the breaking moment) was found to be 5,813 mm. The texture analysis graphic of the play dough obtained using clay is given in Fig. 7.

Fig. 7 Clay texture analysis of the game obtained using clay

For the play dough obtained using clay, each color shows the same sample but different pieces. According to the result of the sample, the highest force value to be applied for breaking the specimen was found to be 12,276 force (g). The distance (mm) was found to be 6,192 mm. The texture analysis graphic of the play dough obtained using tragacanth is given in Fig. 8.

Fig. 8 The texture analysis graphic of the play dough obtained using tragacanth

For the play dough obtained using the tragacanth, each color shows the same sample but different pieces. According to the result of the sample, maximum force value required to break the specimen was found to be 14,075 force (g). The distance (mm) was found to be -0.183 mm. According to the results of the texture analysis of the obtained play dough, the Force (g) required to break the specimens and elongation distances (mm) up to the breaking moment is the highest for the play dough that obtained without heat treatment.

3.2 Interactions between Fiber Materials and Cellulose in Used Plants

For bonding between cellulose and dyestuff molecule (Fig. 9), the H atoms release with interaction between the oxygen(3) in the quercetin molecule structure and the hydrogen(1) in the cellulose structure, and again the oxygen(4) in the quercetin and the hydrogen(2) in the cellulose structure [11].

Fig. 9 Chemical structures of cellulose and dyestuff molecules

Here too, the interaction occurs for giving chemical bond between the oxygen(3) in the indican molecule and the hydrogen(2) in the cellulose structure, again the oxygen(4) in the indican and the hydrogen(1) in the cellulose. Similarly, chemical bonding occurs between the O(3) and the H(1) in the cellulose structure, again the O(4) of the juglon and the H(2) in the cellulose molecule [11].

Fig. 10 Structures of curcumin and betanin

As mentioned above, chemical interaction occurs between the oxygen atom (3) in the curcumin and the hydrogen atom (1) in the cellulose, and again between the oxygen atom (4) of the cucumin and the hydrogen atom(2) in cellulose (Fig 10).

For betanin, the interaction between the oxygen atom (3) of the molecular structure of the betanin and the hydrogen atom(1) of the cellulose structure, and the oxygen atom (4) of the betanin and the hydrogen atom (2) of the cellulose cause to the chemical bonding.
The resulting doughs were stored in two separate parts of the refrigerator. The first deterioration in the samples stored at 4 °C at the lower refrigerator temperature occurred after 119 days, the upper refrigerator temperature - at 18 °C the first deterioration occurred after 186 days. The first deterioration occurred 12 days after the samples were kept closed at 20-22 °C in room conditions. In the samples left with open mouth, it was completely dried at the end of the 3rd day with the crust on the upper surfaces at the end of the first day.

If evaluated in terms of odor, it was observed that there was a sharp smell in the play doughs obtained with purple cabbage. In this sense, rosewater was used as an essence to eliminate smell and there was a decrease in smell perceived.

When all methods are analyzed we can say that if the first choice is color we may use the play doughs obtained unheated methods; if the first choice is to use a long time, we may use play doughs obtained from tragacanth.

4. Conclusion

When all the study results are evaluated, it is the stage of maximization of the deterioration period at the point room conditions where the project should be developed or supported. It is thought that the bay leaf used to extend the decay time of the foodstuff can be extended for only 2-3 days but this time is not enough. The pungent smell of some plants or fruits may be disturbing to the person/persons using the dough. In this sense, research and development should be done in such a way that the naturalness of the formulation does not deteriorate in order to eliminate the smell of the plants.

It is thought that because of its organic nature, its ingredients are not harmful to health, and that the play doughs we produce today, which our families and all humans avoid from synthetic products, will appeal to large masses.

References