Identification of Acidic and Basic Dyes in Different Candies

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ABSTRACT

Synthetic food colors are added in different food items. These colors directly affect consumer food selection and acceptance. Synthetic colors on the basis of solubility are categorized into acidic (permitted) and basic (non-permitted). The present study was conducted to check the synthetic color present in branded and unbranded candies it is either acidic or basic. For this purpose, 15 samples were collected and analyzed in Food Science and Technology Laboratory of the University of Haripur. It was observed that all tested samples contain acidic colors when 20 grams of grinded sample and 5 ml of acetic acidic were taken. The present of acidic synthetic colors may lead to the conclusion that these tested candies can be used at permissible concentrations of dye without any risk to human health. The use of basic colors may cause human health affect from mild to severe whereas permitted acidic colors are safe to use if use within permitted range.

Keywords; Synthetic color, Acidic dye, Basic dye, Analyzed

Chapter 1 INTRODUCTION

A food color is any substance that has capability to enhance the color of the food when it is added intentionally. There are two types of color additives, i.e synthetic and semi-synthetic color or natural color. The natural colors are obtained from the plants or animals. Turmeric and saffron are two examples of this kind (Poul*et al*., 2009; de Andrade*et al*., 2014). They do not cause any health issue as well as they also contain substances that are valuable to human health (Kamatar, 2013). Whereas synthetic colors are not originated from the plants or animals, they are made from the different chemicals in factories. They are mostly water soluble and are used in food without any change (Gerasimov, 2000; Gerasimov, 2001; Alghamdi *et al.*, 2005). In 1856, Sir William Henry Perkin was the first one who developed the first synthetic color and by the turn of century, the use of synthetic colors has been popular throughout the USA and Europe in almost all food stuff like mustard, jellies, ketchup and wine. At that time more than 80 colors were sold of which some were used for dyeing textiles, not for foods. Since the starting 1900s, the most artificial colors were originated from aniline, a toxic petroleum product (BFSA, 1989). Due to more stability its demand is high. In addition, they are less expensive, add no flavor, blend more easily and more concentrated. Coal tar is also a major source from which many of synthetic dye are derived. Much care is required due to synthetic colors are active chemicals (Ashfaq and Masud, 2002). Some of them cause health problems whereas if they are used in large quantity (above the prescribed value) it has carcinogenic effect (Robens *et al.*, 1980). In the past, artificial colors were interrelated with hyperactivity in children (Redlinger and Nelson, 1993).

Synthetic dyes are classified on the basis of their solubility and chemical properties into acidic and basic dye and other categories. Acidic dyes are anionic that are water soluble. By utilizing neutral to acid dye baths, acidic dyes are used to dye the fibers like silk, wool, nylon and altered acrylic fibers. These dyes are used for fiber by formation of salt between anionic groups in the dyes and cationic groups in the fiber. Majority of food synthetic color are acidic in nature. While the basic dyes are water-soluble cationic dyes that are also used for the dying acrylic fibers, but its use for wool and silk is limited. In addition, papers are also colored by this category of dye (Booth and Gerald, 2000). Synthetic colors (basic color) do not contain groups

that form salt as water-soluble colors. Such colors are soluble in oil or organic solvents (Demirağ and Uysal, 2006). Anionic dyes are direct, acid and reactive dyes whereas cationic (basic dyes) are non-ionic and zwitter ionic depending on the ionic charge on the dye molecules. Basic dyes are more toxic as compare to acidic dyes (Nandi *et al.*, 2009).

Synthetic food colors have been lawful and regulated for use in food additives in many countries (MHLW, 1947;EC, 1994;FDA, 2004). Different food colors are used in innumerable kinds of toffees, ice-cream, jam and jellies as well as it is also used in bakery products like biscuits, pastries and cakes. The basic purpose of addition of this food additive is to increase the appeal of various kinds of food stuff in order to catch the attention of customers. Both large manufacturers and street vendors do this activity (Maurer *et al.*, 1980; Davis *et al.*, 1964).

There are many different permitted acidic synthetic colors that are used in different candies within permitted range. But there is a possibility of use of basic dye (non-permitted) due to consumers demand and variety in different foods. The traders make their food stuffs look superior and appetizing to increase sale and profit. Therefore, different candies of different industries were collected from the local market of the district Haripur, Khyber Pakhtunkhwa in order to check the dye present in them either permitted acidic dye or basic non-permitted.

The main objective of this study is following to check the color in different candies either it is acidic or basic dye.

Chapter 2 MATERIALS AND METHODS

2.1 Experimental site

This study was conducted in Food Science and Technology Laboratory, the University of Haripur.

2.2 Collection of sample

15 Samples of candies of different industries werecollected from local market of the district Haripur, Khyber Pakhtunkhwa.

2.3 Sample Storage

Tested samples were stored at room temperature till analysis.

2.4 Sample Preparation

Following the modifiedmethod described byFSSAI, (2015)the 20 grams (10 grams is described value) of sample was thoroughly grinded with pestle and mortar. Thereafter, it was properly mixed with 50 ml of 2 % ammonia in 70 % alcohol that was taken in beaker and it was stand for an hour. After that, the sample was poured into falcon tubes and centrifuge at 2000 rpm for 20 minutes. The liquid portion of centrifuged sample was poured into a rotating flask and evaporated on rotary evaporator at 50°C till concentrated. Thereafter, the concentrated sample was mixed thoroughly with 5 ml dilute acetic acid (3:1). The 30 ml acetic acid is defined value in the method.

The same procedure was adopted in making the sample of powder food color Red (E 102, E 171, E 122, E 129) and local Green except 0.45 grams (derived from the described value) powder color was taken.

2.5 Preparation of White knitting wool

To take out fat from the white wool, soxhlet extractor with petroleum ether was used for 2-3 hours. Thereafter, the white wool was removed from the thimble and boiled in the 0.1 N dilute solution of sodium hydroxide and then in water to make the

wool free from alkali. Both boiling processes were taken on magnetic stirrer with hot plate.

2.6 Extraction of the color from the Sample

The 20 cm length of woolen thread was cut with cutter and introduced into the beaker that had about 10 ml solution of the already prepared acidified solution of the sample. It was boiled till the woolen thread was dyed. After that, woolen thread was removed from the boiled acidified solution of sample with the help of spatula and tap water was run over. Same treatments were applied with powder synthetic dyes.

The one normal ammonia was prepared and washed woolen thread was introduced into beaker that had dilute ammonia (1 N) and boiled again. If the color of the thread is taken by the ammonia solution, it indicates that it is an acidic synthetic dye which is permitted.

In order to get the pure color extraction, double stripping technique" is used. In this technique, dyed woolen thread is removed from the beaker containing ammonia. Then, the ammonia solution is made slightly acidic and boiled with a fresh piece of woolen thread of 20 cm length. It is boiled continually until the color is stripped by the woolen thread. The dye is again removed from the thread by using 1 N ammonia which is then filtered by a small piece of cotton. The filtrate is concentrated on the hot water bath.

It is the possibility that woolen thread may dye by the natural color, but it is not removed when it is treated with ammonia. For the identification of basic dye, prepared sample is alkaline by the ammonia and then boiled with wool and stripped with dilute acetic acid which is non-permitted.

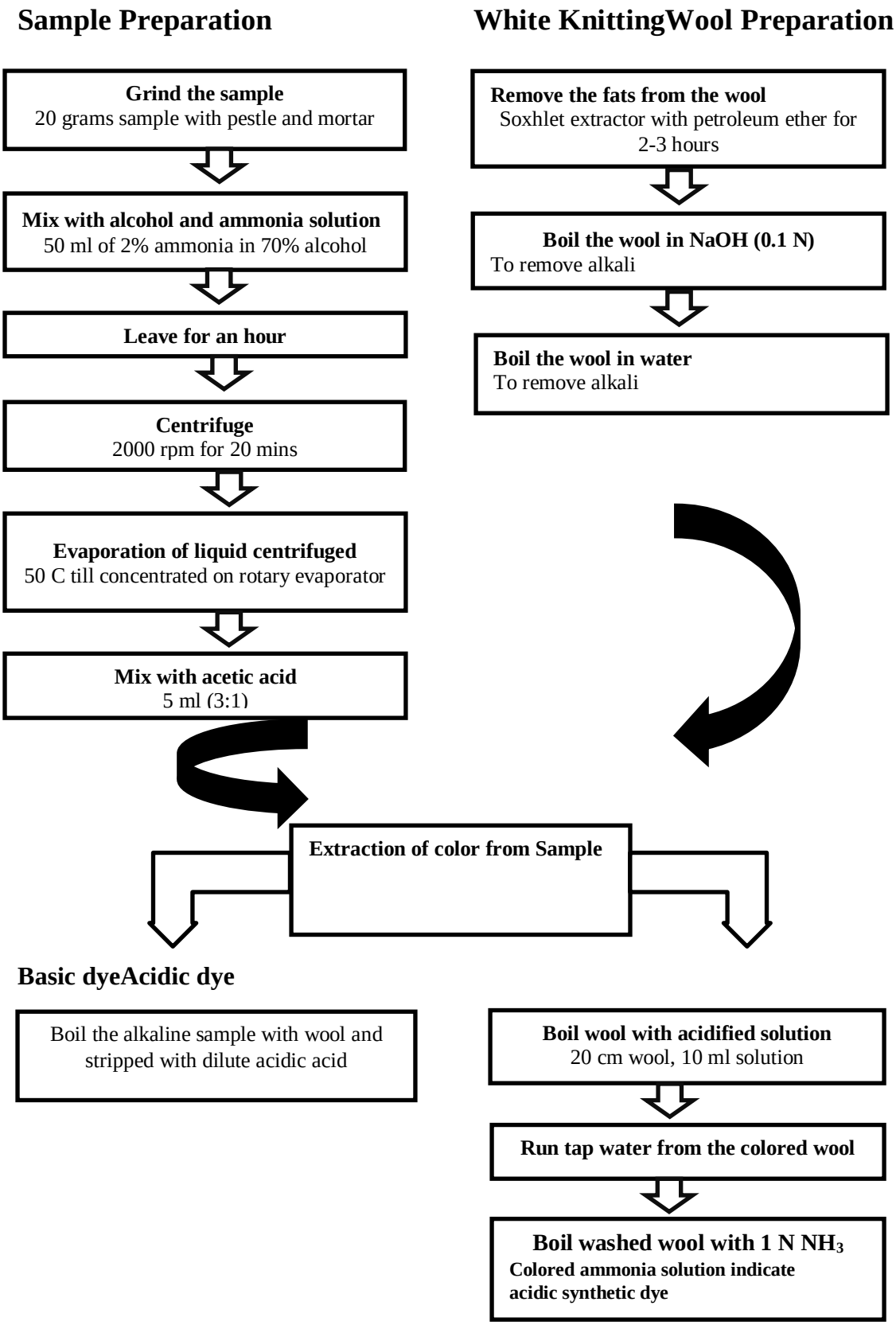


Figure 1: Flowchart for the identification of acidic and basic dye

Chapter 3 RESULTS AND DISCUSSION

The candies were analyzed in order to check the color present in it either basic or acidic. Tests were performed on the different candies which collected from the local market (Table 1). The tests were also performed on the powder food color Red (E 102, E 171, E 122, E 129) and local Green to verify the procedure.

Table 1 and pictures illustrate that all candies as well as powder food colors contain the acidic color (Positive results). The candies showed these results when 20 grams grinded sample of candies and 5 ml acetic acidic were used. In case of powder food color 0.45grams quantity (derived from the described value) and 5 ml acetic acidic were used. The reason behind taking 5 ml acetic acid instead of 30 ml was, on washing with tap water the wool sustained little bit the color which it attained from boiling with already prepared acidified solution on magnetic stirrer with hot plate and ammonia solution stripped the dyed wool color (after tap water washing). Moreover, same case with taking the 20 grams quantity of sample (10 grams is described value).

Results obtained from this study werecontrary with the results ofSaleem and Umar, (2013) that reported the colors present in the examined samplesas permitted food colors wereSunset yellow, Tartrazine,Ponceau4R and AmaranthwhileOrange 11,Metanil yellow and Congo Red were found as non-permitted food colors which were found in local products selling around the education institute of Karachi city.Chaleshtor and Golsorkhi, (2016)reported72 samples (48.30%) contained no food color and 77 samples (51.7%) contained artificial dye. Most of the colorants were sweets (72.7%), beverages (51.2%) and meat samples (48.10%). Quinoline yellow, sunset yellow and tartrazine are the most commonly used colorants in a variety of foods. Approximately 52% of inspection foods contain artificial colors that are prohibited by the Iranian National Standards Organization.In similar study, Arast *et al.*, (2013)reportedartificial colors were present in 48% different confectionary products. Moreover, Ashfaq and Masud, (2002)reported that 47.56% of the samples(confectioneries andsweet meats) consisted of non-permitted food colors.

Almost all the tested samples contained E-102, E-122, E-124, E-129, E-133 and E-150 number colors range. Up to 0.1 g/Kg can be used in different foodstuffs

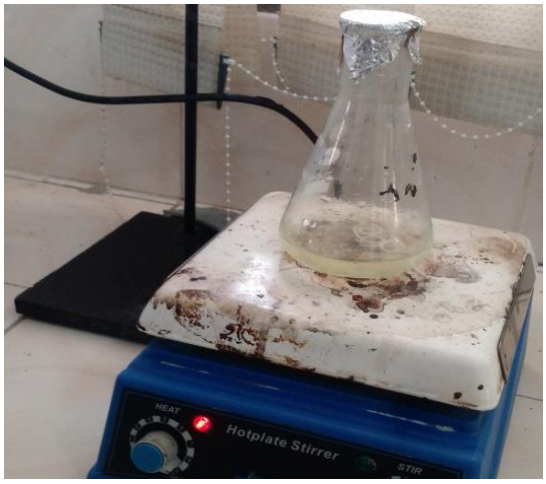
which is maximum allowable value. The Acceptable Daily Intake (ADI) has been characterized as the measure of a substance that can be utilized ordinarily all through the lifetime of a person with no health issue(JECFA, 1994). According to (IARC, 1978)checking of basic color contaminants in handled foods is important to guarantee food safety. It is declared that Rhodamine B is carcinogenic and not good for health.

Table 1: Acidic and basic color analysis of candies

Serial. Number	**Name of Samples**	**Acidic dye, Basic dye** [+means acidic - means basic]
1	Sample 1	+
2	Sample 2	+
3	Sample 3	+
4	Sample 4	+
5	Sample 5	+
6	Sample 6	+
7	Sample 7	+
8	Sample 8	+
9	Sample 9	+
10	Sample 10	+
11	Sample 11	+
12	Sample 12	+
13	Sample 13	+
14	Sample 14	+
15	Sample 15	+
16	Powder Food Color Red (E 102, E 171,E 122 E 129)	+
17	Powder Food Color local Green	+

ACIDIC FOOD COLOR TEST

Sample 1



Positive

Sample 2

Positive

Sample 3

Positive

Sample 4

Positive

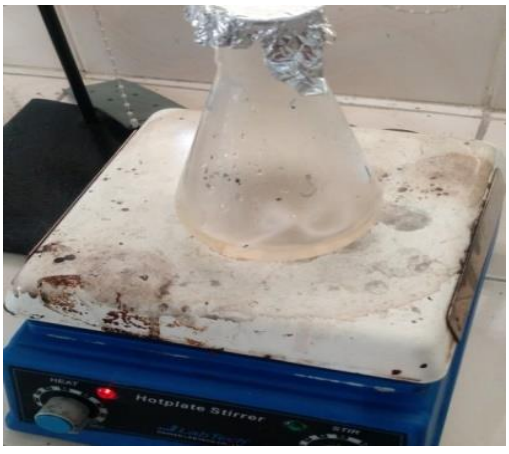
Sample 5

Positive

Sample 6

Positive

Sample 7



Positive

Sample 8

Positive

Sample 9

Positive

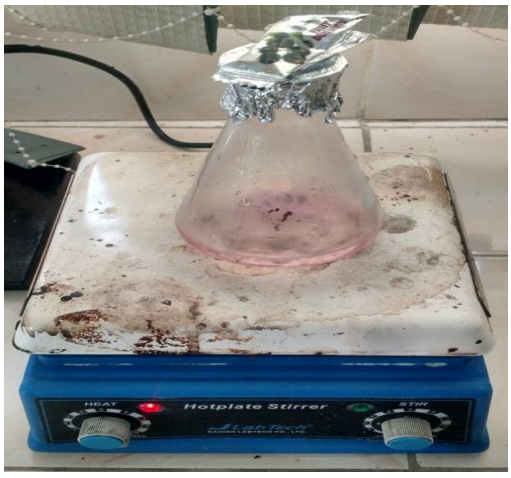
Sample 10

Positive

Sample 11

Positive

Sample 12



Positive

Sample 13

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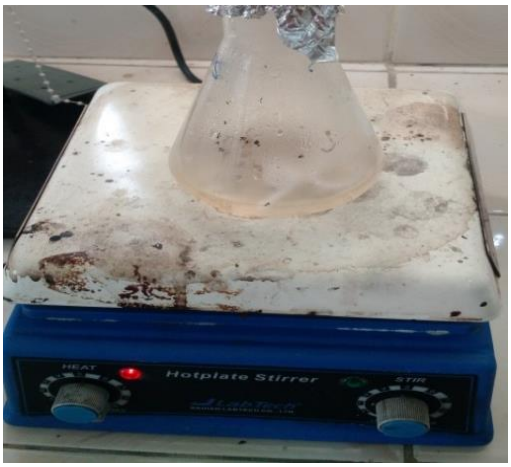
Positive

Sample 14

Positive

Sample 15



Positive

Powder Food Color Red

Positive

Powder Food Color local Green

Positive

Chapter 4 CONCLUSION

From the present study, it is concluded that the branded and unbranded tested samples selling in the local market of the district Haripur, Khyber Pakhtunkhwa contain permitted food colors (acidic dyes). It was observed that knitting wool sustained little bit the color after washing with tap water which it attained on boiling with already prepared acidified sample and ammonia solution stripped the dyed wool color (step done after tap washing) if the 20 grams sample of candies and 5 ml acetic acid were taken. The reason behind this fact was, knitting wool did not sustain the color on tap washing, if 30 ml acetic acid was used that described value of acetic acid in the method. Furthermore, the quantity of food color used in the candies is generally lower that was not enough quantity for sustaining wool dye on tap washing when 10 grams grinded sample of candies was utilized.

REFERENCES

Alghamdi, H., Alghamdi, F.,&Alwarthan, A. (2005). Spectrophotometric analysis of artificial food colors in commercial drinks consumed by children. *Journal of Saudi Chemical Society*, 9, 1-10.

Arast, Y., Mohamadian, M., Noruzi, M., & Ramuz, Z. (2013). Surveillance on artificial colors in different confectionary products by chromatography in Qom. *Zahedan Journal of Research in Medical Sciences*,15(3), 62-64.

Ashfaq, N., & Masud, T. (2002). Surveillance on artifical colours in different ready to eat foods. *Pakistan Journal of Nutrition*, 5, 223-225.

BFSA. (1989). Bangladesh standard list of permitted food additives and their permissible limits of use. Part 1 color, preservatives and thickening or gelling agents.*First Revision: BDS 1012 (Part 1)*: Bangldesh Food Safety Authority.

Booth &Gerald.(2000).*Dyes, general survey.* Wiley-vch.

Chaleshtor, R. S., & Golsorkhi, F. (2016). Determination of Synthetic Colors in Some Locally Available Foods of Kashan City, Iran.*International Archives of Health Sciences*,3(2), 61-66.

Davis, K. J., Fitzhugh, O. G., &Nelson, A. A. (1964). Toxic. Appl. Pharmacol. 66:25:23.

Demirağ, K., & Uysal, V. (2006). Renklendiriciler in: altuğ t, editor. *Gıda katkı maddeleri. Meta basım, izmir*,169-191.

EC. (1994). European parliament and council directive 94/36/ec on colors for use in foodstuffs: European Council.

JECFA. (1994). Summary of evaluation performed by theJECFA: Joint Expert Committee for Food Additives.

FDA.(2004). Summary of color additives listed for use in the United States in food, drugs, cosmetics and medical devices: Food and Drug Administration.

FSSAI.(2015). Manual of methods of analysis of foods, food additives.*FSSAI, Ministry of India:* Food Safety and Standards Authority of India.

Gerasimov, A. (2000). Qualitative and Quantitative treatment of thin-layer chromatograms of incompletely separated synthetic food colors. *Journal of Analytical Chemistry*,55(12), 1161-1165.

Gerasimov, A. (2001). Color characteristics of aqueous solutions of synthetic food dyes. *Russian journal of applied chemistry,*74(6), 993-997.

IARC.(1978). Monographs on the evaluation of carcinogenic risk to humans. 16, 212-231: International Agency for Research on Cancer.

Kamatar, D. M. (2013). Natural food coloring: a healhier alternative to artificial food coloring.

Maurer, T., Weirich, E., & Hess, R. (1980). The optimization test in the guinea pig in relation to other predictive sensitization methods. *Toxicology,* 15(3), 163-171.

MHLW. (1947). Food sanitation act. *Act no. 233 of December 24*: Ministry of Health, Labour and Welfare.

Nandi, B., Goswami, A., & Purkait, M. (2009). Removal of cationic dyes from aqueous solutions by kaolin: kinetic and equilibrium studies. *Applied Clay Science,* 42(3-4), 583-590.

Redlinger, P., &Nelson, D. (1993). Food additives what are they? *North Central Regional Publication,* 438.

Robens, J. F., Dill, G. S., Ward, J. M., Joiner, J. R., Griesemer, R. A., &Douglas, J. F. (1980). Thirteen-week subchronic toxicity studies of Direct Blue 6, Direct Black 38, and Direct Brown 95 dyes. *Toxicology and applied pharmacology,* 54(3), 431-442.