Republic of Iraq

Ministry of Higher Education and Scientific Research

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College of Biotechnology

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Study of photodecomposition of some food dyes with its biological activity

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Abstract:-

This research includes the photo decomposition of three known Food Dyes: Tartrazine (dye1), Carmoisine (dye2) and Brown HT (dye3), by irradiation of them aqueous solutions by low pressure mercury lamp fitted with a power supply and emits UV light in the wavelength range 365 - 579 nm, at 25˚C for 60 min in Distilled water. The mechanism of dyes decomposition has been interpreted that there is redox- reaction has been happening in these dyes. To optimization conditions of decomposition, the effect of dyes on the biological efficacy of three types of bacteria (ecoli, streptococci and staphelococi) was studied before and after the photo decomposition. It was found that the treatment of bacteria with dye solutions after photo decomposition, had a significant impact on the inhibition of the effectiveness of this bacteria, compared to the solutions of dyes before photo decomposition.

Introduction:-

Food Dyes:

In recent years, following the major development in the food industry, marketing and increasing consumption, it is necessary to add many chemicals such as preservatives, dyes and flavors that increase their nutritional value and taste, as well as attract the consumer as a marketing tool. Food dyes are important additives for food and medicines It is widely used and has more than 2,500 species with an annual production rate of more than 8 million tons [1, 2]. These dyes may be either natural or industrial in origin. 95% of the dyes used in recent years are due to industrial food dyes due to cheap prices and easy production [3, 4].

Food dyes have long been added to many basic foods such as cheeses, dairy products, ground fish, meat products, ice cream, juices, jam and sweeteners [5, 6]. Recent studies have clearly focused on many industrial food dyes that have prevented the use of some of them Is controversial because of its toxic or carcinogenic effects, and there are many studies that have included her studies

About the metabolic and toxic disturbances caused by these pigments on rats and some other species [7,8,9]. Moreover, many of the AZO compounds have a toxic effect or are implicated on laboratory animals[10, 11].

Chemical effects of food dyes:

Food dyes are one of the azo compounds containing the azo-bisexual, binary-linked, aromatic system, which is classified as monoclonal, bipolar, and triglyceride. There are more than 3000 types of iso dyes, which are widely used in foods [12,13] . These dyes contain aromatic amines. Reductase enzymes, after transmission from the wall of the small intestine, the liver, as they are fully reduced, the aromatic amines are oxidized oxidation enzymes such as p450 N_hydroxy derivatives and occurs in most mammals such as human [14,15]. And the effect of carcinogenic or toxic The dye of food is either directly or indirectly through the biological transformation of the AZO compounds in the metabolic processes and the use of these dyes by the human for a

long time causes some diseases such as anemia, indigestion, liver diseases, kidneys, spleen and lack of growth and diseases of sensitivity and rash [13].

Tartrazine (dye1):

Tartrazine is an anionic, hydrophilic azo dye with an orange-yellow color used in fabrics, foods and cosmetics, and as a biological stain.

It is used in the manufacture of soap, ice cream, soft drinks, all spices and alcoholic beverages [12]. It is used in the manufacture of soap, ice cream.

Chemical Names: Tartrazine; Yellow 5; Aizen tartrazine; Atul Tartrazine; Erio Tartrazine
Molecular Weight: 534.356 g/mol
Molecular Formula: $C_{16}H_9N_4Na_3O_9S_2$, as shown in (Fig.1).

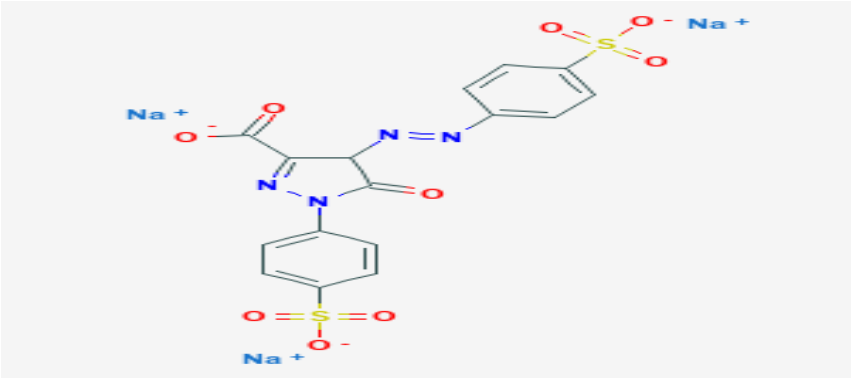

Fig. 1. Tartrazine.

Carmoisine (dye2):

The chromosin of the industrial food dyes first used in America in 1939 [16], is the source of the azo compounds and is made from coal tar or dizinium salt through a group of N = N, which are highly reactionary hydrocarbon compounds with high solubility in the water, The color enhancement and the means of attracting the consumer are used. This dye is used in many areas, including the toothpaste and after eating the foods containing the chromosine dye, will be reduced by the enzymes of cytochromes p450 Aromatic amines [17,18].

Chemical Names: Carmoisine; Azorubin; Chromotrope FB; Azo Rubine; Azo rubin S; Acid red 14 .

Molecular Weight: 458.459 g/mol

Molecular Formula: $C_{20}H_{14}N_2O_7S_2$, as shown in (Fig.2)

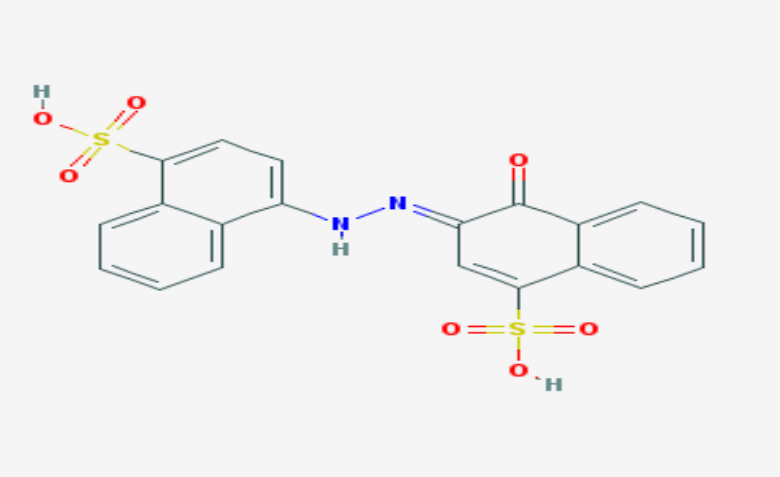

Fig. 2. Carmoisine.

Brown HT (dye3):-

Brown HT (Fig. 3) is the disodium salt of 4,4′-[(2,4-dihydroxy-5-hydroxymethyl)-m-phenylene)-bis(azo)]-di-1-naphthalene-sulphonic acid. There are at least 10 synonyms for this compound. The most commonly used synonyms in published literature are Brown HT, Chocolate Brown HT and CI Food Brown 3 [19]. It presents very good stability in light and heat [20]. Brown HT is permitted for use in the UK under the Colouring Matter in Food Regulations, and its review by the EEC authorities is pending. The principal uses of Chocolate Brown HT are in flour and sugar confectionery, canned meat, ice cream, soft drinks, puddings and sauces [21].

Chemical Names: Certicol Brown RS; Chocolate brown HT; Certicol Brown N Extra; Brown HT; C.I. Food Brown 3; 1538 Brown

Molecular Formula: $C_{27}H_{18}N_4Na_2O_9S_2$

Molecular Weight: 652.56 g/mol.

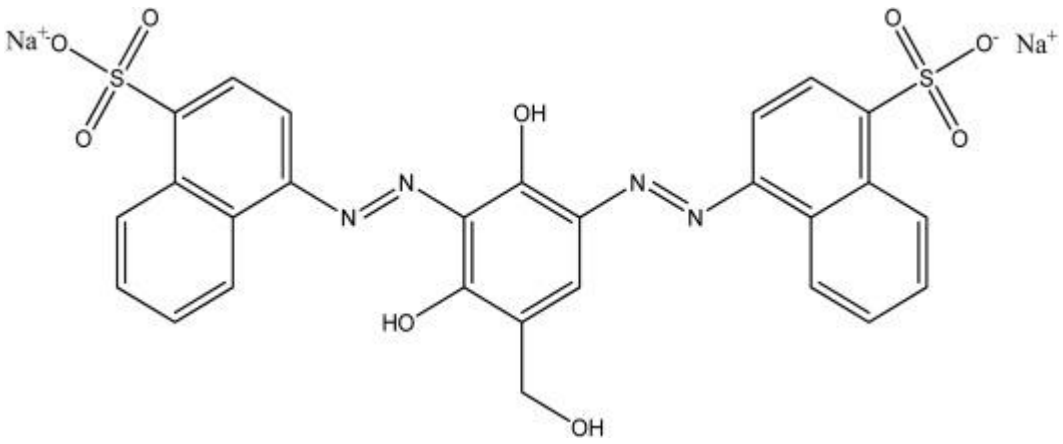

Fig. 3. Molecular structure of Brown HT.

Purpose of the research

1- **Studying the photo decomposition of some known Food Dyes**.
2- **Determine the effect of them on the biological efficacy of bacteria.**

Experimental

Chemicals and Instruments:

Materials and methods :

- **Instruments and Equipment's :**

NO	equipment	company
1.	Low pressure mercury lamp	LLE-1 (Lambda),
2.	Spectrophotometer	Optima
3.	Triple Beam Balance 2610	TAFESA(Germany)
4.	Incubator	BINDER
5.	Autoclave	HVE-50
6.	Refrigerator	DAIREI
7.	Laminar Air Flow(hood)	Prutscher
8.	Benzene burner	Shndon (England)
9.	Water Distillatory	Gallenkamp (England)
10.	Glass cylinder	AFMA-Jordan
11.	Pyrex® Glass Flask	AFMA-Jordan
12.	Plastic Petri dishes	AFMA-Jordan
13.	Plastic tubes	AFMA-dispo
14.	Loop Full	KD SURGICALS-INDIA
15.	Gloves and mask	Slibrand-China
16.		

- **Material and media :**

NO	Material	Company
1.	Glycerol	BDH (England)
2.	Blood agar base	HIMEDIA
3.	MacConkey's agar	HIMEDIA
4.	Nutrient broth	CONDA
5.	Nutrient agar	CONDA
6.	Mueller-Hinton agar	HIMEDIA

- **Chemical dyes :**

NO	Chemical dyes	Company
1.	Carmoisins	India
2.	Brawn H	India
3.	Tartrazine E102	India

Result and Discussion:-

1- **The effect of irradiation time and dyes concentration:**

2- **The absorbance was measured during the period time range between 0-60 min, fig.4 shows the effect of the change in the time of irradiation on dyes absorbance, were shows the low absorption at irradiation continue.**

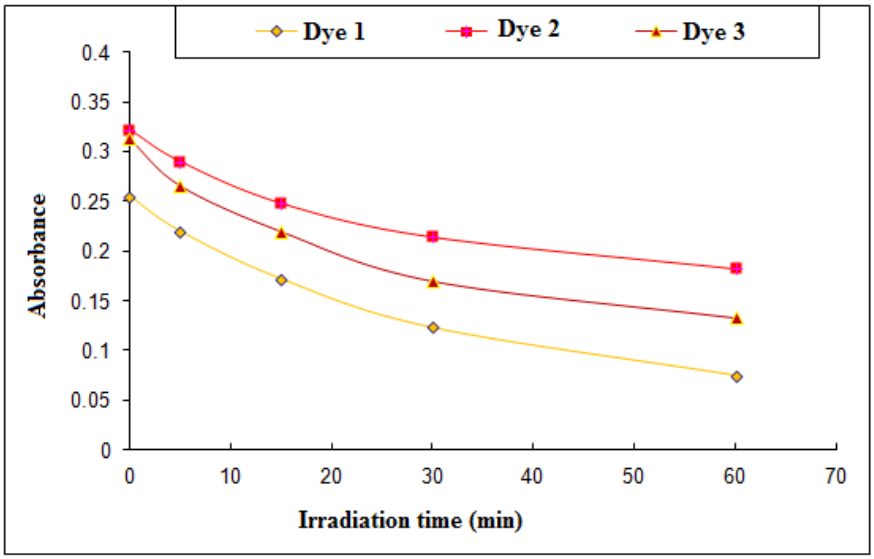

Fig. 4:- The time of irradiation of dyes versus absorbance.

3- **The effect of dyes on the biological efficacy of bacteria**:-

2-1 Before Irradiation of dyes:

2-2 Bacteria were treated with dye solutions prior to the process of optical disintegration. The following concentrations were used for dye solutions (1 * 10-4, 1 * 10-3).

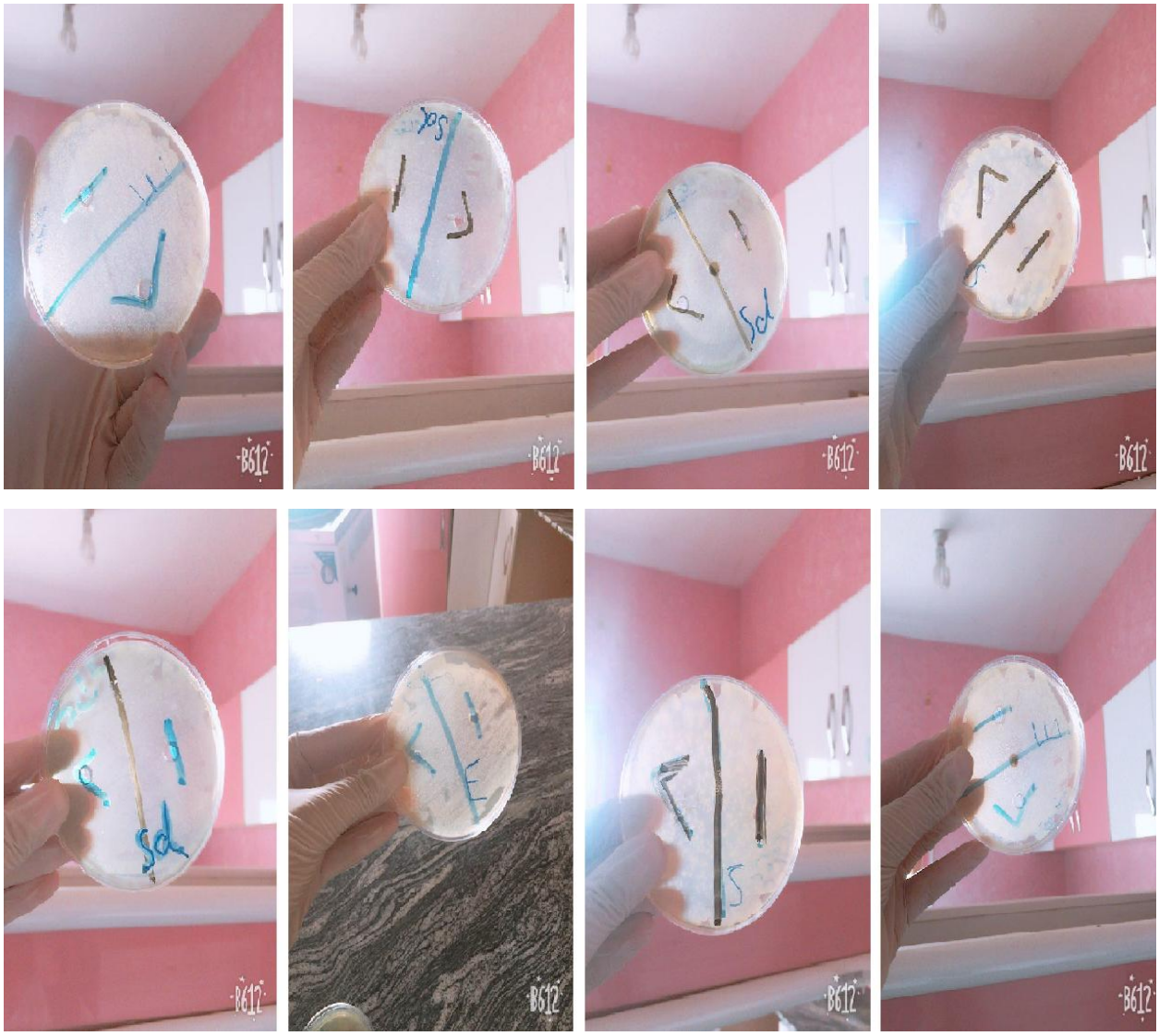

Fig. 5 The effect of dyes on the biological efficacy of bacteria before the photo decomposition.

2-3 After Irradiation of dyes:

The bacteria were treated with dye solution after photolysis. The following concentrations were used for the dye solutions (1 * 10-4, 1 * 10-3). The results were positive which proves that the efficacy of bacteria is inhibited by the degradation products of the studied dyes .

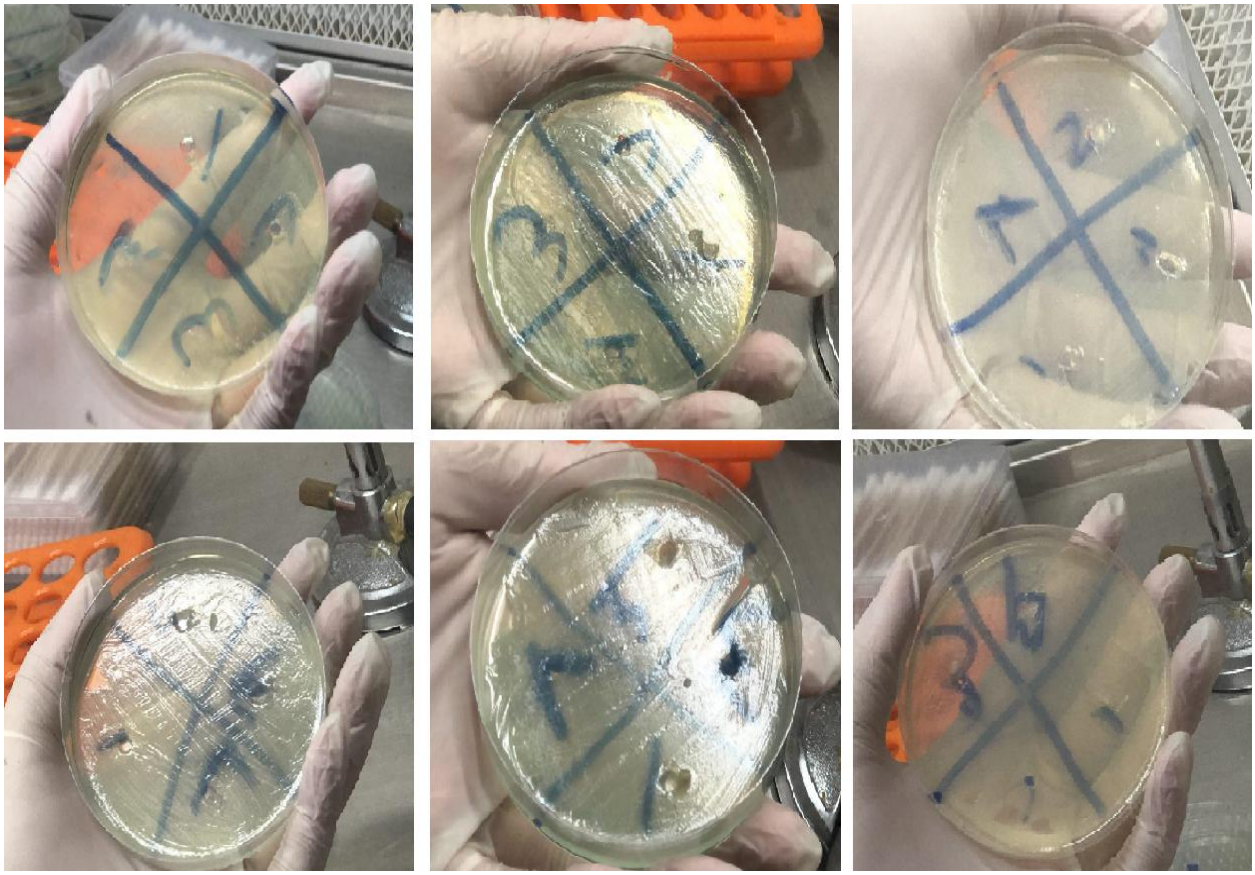

Fig. 5 The effect of dyes on the biological efficacy of bacteria after the photo decomposition.

Conclusion

Through laboratory experiments of industrial food dyes that have been used with juices, moisturizers and some foods Preferably stored in the environment away from light because it will affect them and cause a defect in its composition and free roots.