Introduction*:*

Sugar cane molasses is a by-product of the sugar cane industry. It contains monosaccharaides (glucose and fructose) and a disaccharide (sucrose) in high concentrations **(Portilla et al., 2009).** It contains water (20%), sugar contents 62%), non-sugar contents (10%) and inorganic salts "ash contents" (8%): making a blackish homogenous liquid with high viscosity. Ash contents include ions such as Mg, Mn, Al, Fe and Zn in variable ratio **(Ali et al., 2002).**

Molasses is used as a potential raw material to develop nutraceutical products for iron deficiency anemia (IDA). Molasses contains iron and its absorption enhancers, such as sulfur, fructose, and copper, which make it a potential dietary supplement for IDA. **(Jain and Venkatasubramanian, 2017**).

Activated carbon is a carbonaceous material which is predominantly amorphous in nature and in which a high degree of porosity is developed by the process of manufacturing and treatment. Activated carbon can be manufacture from virtually all carbonaceous materials. However agricultural wastes offer the most available and cheapest of all the known raw materials. Activated carbon is inexpensive and hence very widely used adsorbent. **(Abechi et al., 2013).**

Clarified molasses using in some minor food. It is used as a sweetener, beverage as syrup accompanying other foods: molasses also as the starting product for the preparation of other edible syrups such as treacle. Molasses used in food product development and as additives in barbecue sauces, bakery products cookies and production of high fructose syrup (**Dotaniya et al., 2016).** This study aims to determine the effect of different levels of charcoal on the physical properties and chemical composition of the sugar cane molasses, which play an economical important role as the goal of this investigation.

Materials

Molasses: Sugar cane molasses samples used in this study were obtained from Nag- Hammady sugar factory during the 2015 (operation season).

Activated carbon (charcoal): Charcoal was obtained from El Gomhoria Company for Pharmaceutical Trading Chemicals and Medical Supplies in Assiut.

Methods

Preparation of clarified sugar cane molasses

Sugar cane molasses samples were mixed well, and then 300,400 and 500 gm of mixed molasses were diluted to liter with distilled water (w/v). Activated carbon (charcoal) at 6, 8 and 10% were blended with diluted molasses samples. The mixture was heat up to 75 ºC for 1 hr., coagulated protein and plant pigment causing to float to the surface and form a scum on top of the flask. This layer is skimmed off by hand, according to **Hurst (1985) and Siva Subramanian and Pia (1994**): The mixture was left to cool at a room temperature; the treated samples were centrifuged for 10 min at 400 r.p.m. The supernatant was followed using a filter aid.

Physical properties:

Color: The color of the diluted purified solution was measured colorimetrically using a “Beckman colorimeter” with a reel filter and expressed as a % transmission (T %) according to **(Plews, 1970)**.

pH value: Samples of molasses should diluted to 60 Brix (77,19 gm. of original molasses: 100 ml of hot distilled water), and must be cooled to room temperature before pH measurement, by a “Beckman pH meter”. It was carried out according to **(Collins et al., 1977).**

Chemical composition

Protein content :

- Protein content was calculated by the equation:
- Protein content = organic nitrogen × 6.25
- Organic nitrogen = total nitrogen – inorganic nitrogen
- Total nitrogen and inorganic nitrogen contents were determined by the methods described in **A.O.A.C. (2016).**

Crude lipid content: The studied samples were treated by strong solution of base lead acetate, then, filtered and dried at 60 ºC. The dried samples were extracted by Soxhelt apparatus and using tetra chloride as a solvent as determined by **Smith and Reeves (1981).**

Ash content: The method described by **A.O.A.C (2016)** was used. Ash determination was carried out at 550 ºC with 2 gm. of samples. The water soluble and insoluble ash and its alkalinity were measured by methods described in **A.O.A.C (2016).** Meanwhile, the acid soluble and insoluble ash was determined applying the method outline in **the State Pharmacopoeia of the People̓s Republic of China (2005).**

Total sugar content: Total sugar content of samples was determined by the analytical method that carried out as described in **EOSQC (1995).**

Sucrose content: Sucrose content of samples was determined by the Lane and Eynone method as described in **ICUMSA (2009)** method.

Sucrose % = (% reducing sugars after inversion - % reducing sugars before inversion) × 0.95.

Reducing sugars content: Reducing sugars content of samples was determined by the Lane and Eynone volumetric method as described in **ICUMSA (2009)**.

Titratable acidity: Titratable acidity was measured by **Eggleston et al., (2000)** method.

Results and discussion

Molasses composition would make it suitable for human consumption provided it is manipulated in such a way to clarify free from foreign matter and adjust the concentration of some of its components.

Data presented in tables (1-5) showed that ability of activated carbon to remove of the polymeric caramels, alkaline degradation products and melanoidins. It is due to the formation of a mild links between the colorant amino groups, and carbonyl groups. (**Leimkuehler, 2010).**

Clarification of molasses was found to be quite difficult and tedious it was of its high viscosity. Thus, clarification was done on water diluted molasses at a rate of 300, 400 and 500 gm per liter of distilled water. Higher concentrations showed similar difficulties as undiluted molasses: Diluted molasses was heating at 75 ºC for 1 hr, and cooling at room temperature overnight after adding amount of charcoal. The results showed that in almost all cases, the clarified solutions obtained were 80 % in volume of the original solutions used. The greatest drop in volume was observed when the concentration of molasses reached 500gm per liter. The decolorization efficiency of charcoal decreased as the concentration of molasses increased in the solutions. The best condition to improve decolorization is to increase the amount of charcoal. The best economical results in this respect were obtained upon charcoal at the rate of 10% of the weight molasses.

The greatest drop in volume was observed when the decolorization efficiency of charcoal decreased as the concentration of molasses increased in the solution. However, the increase in the amount of charcoal used in any particular dilution resulted in better decolorization. Data in table (1) revealed that best economical results in this respect were obtained upon charcoal at the rate of 10% of the weight molasses; highly transmission (T %) specially in 300 g/l, high ability to remove impurities.

Table (1): Effect of charcoal levels on color (T %) of diluted sugar cane molasses

diluted molasses gm/l	color (T %)			
	original molasses	charcoal %		
		6	**8**	**10**
300	-	3.6	6.6	16.9
400	-	0.1	2.5	4.1
500	-	0.2	0.6	2.0

T % = transmission %

The pH and titratable acidity (T.A.) of molasses sample are shown in table (2). The both of pH and T.A. have no sharp change comparing with their in original molasses. It is worthy, the increase in T.A. accompanied with non-indefinite raise in pH. This may be due to the reaction between the unstable organic substances with reducing sugars during processing or storage these results agreement with results obtained by **Olbrich (1963**). From tabulated data, T.A. increase with increase of molasses dilution.

Table (2): Effect of charcoal levels on pH and titratable acidity of diluted sugar cane molasses

diluted molasses gm/l	pH and titratable acidity							
	original molasses		charcoal %					
			6		**8**		**10**	
	pH	T.A.	pH	T.A.	pH	T.A.	pH	T.A.
300	5.47	242.46	5.55	233.13	5.55	234.80	5.49	235.46
400	5.47	242.46	5.55	236.46	5.55	241.46	5.50	243.13
500	5.47	242.46	5.46	244.79	5.47	242.46	5.44	243.13

T.A.= titratable acidity

The results illustrated in table (3) showed that clarification slightly increase crude protein recovery in diluted molasses solution. At the first dilution of molasses (300gm/ liter) protein % recorded 0.9, 0.7 and 0.5of 6, 8 and 10 % of charcoal; respectively. But of dilutions of 400 and 500 gm / l were recorded (0.95, 0.8 and 0.7) and (1, 0.85 and 0.7) of 6, 8 and 10% of charcoal; respectively. The results illustrated in table (3) showed that clarification slightly increased the crude protein losses in molasses of the first dilution of 300 gm / l; specially ; 10% followed by 8% and 6% charcoal (0.5, 0.7 and 0.9; respectively) Clarification process greatly increased crude protein losses in wastes in other of two dilution of 400 and 500 gm / l. This is in good accordance with those concluded by **(Barker, 1986)**

The results in table (3) illustrated that no lipid contents were recorded in diluted molasses (300, 400 and 500 g/l) with different concentration 6, 8 and 10% of charcoal while, the original molasses contents recorded 0.28% of lipid. Clarification process was highly efficiency to remove all lipids content.

Table (3): Effect of charcoal levels on crude protein and crude lipid content of diluted sugar cane molasses

diluted molasses gm/l	crude protein and crude lipid							
	original molasses		charcoal %					
			6		**8**		**10**	
	protein %	lipid %	protein %	lipid %	protein%	lipid%	protein %	lipid %
300	3.30	0.28	0.9	0	0.7	0	0.5	0
400	3.30	0.28	0.95	0	0.8	0	0.7	0
500	3.30	0.28	1	0	0.85	0	0.7	0

The results illustrated in table (4) showed that ash content of first diluted molasses (300 gm/ liter) was ranged between 7.87 to 8.66 % but, in other two dilutions of molasses (400 and 500 gm/ liter) the results ranged between (8.1 to 8.71) and (7.97 to 8.29%): respectively of different concentrations of charcoal. Original molasses contents 11.45% ash, these results indicated that chemical composition of sugar cane molasses was in close agreement to those reported by **(Chen and Chou., 1993)** who found that molasses contents 12% ash.

Data presented in table (4) revealed that the clarification of diluted molasses resulted in a considerable diminution in the ash content. Noticeable is the complete removal of acid insoluble ash and the pronounced drop in the water insoluble ash. This explains the advantage of clarification in freeing molasses from sandy substances making it more suitable for edible uses. However, the best clarification was obtained with diluted molasses (300 g/l) with 10 % charcoal. This result agreement with results obtained by **(El-Geddawy et al., 2014).**

Table (4): Effect of charcoal levels on total ash, water soluble ash, water insoluble ash, acid soluble ash and acid insoluble ash of diluted sugar cane molasses

diluted molasses gm/l	original molasses					total ash, water soluble ash, water insoluble ash, acid soluble ash and acid insoluble ash /100g molasses														
						charcoal %														
						6					8					10				
	T.ash	W.S. ash	W.Ins. ash	A.S. ash	A.Ins. ash	T.ash	W.S. ash	W.Ins. ash	A.S. ash	A.Ins. ash	T.ash	W.S. ash	W.Ins. ash	A.S. ash	A.Ins. ash	T.ash	W.S. ash	W.Ins. ash	A.S. ash	A.Ins. ash
300	11.45	8.61	2.83	13.08	0.65	8.66	1.89	8.26	9.89	0.0	6.75	6.13	1.89	9.43	0.0	7.87	6.05	1.81	8.99	0.0
400	11.45	8.61	8.61	13.08	0.65	8.71	1.87	8.28	9.94	0.0	6.48	6.33	1.95	9.45	0.0	8.1	6.33	1.76	9.25	0.0
500	11.45	8.61	2.83	13.08	0.65	8.29	1.70	8.04	9.47	0.0	6.59	6.36	1.67	9.18	0.0	7.97	6.36	1.60	9.10	0.0

T = total ash W.S. = water soluble ash W.Ins = water insoluble ash A.S. = acid soluble ash A.Ins.= acid insoluble ash

The results illustrated in table (5) showed that clarification slightly decrease sucrose recovery in diluted molasses solution. At the first dilution of molasses (300 g/l) recorded 35.1, 34.07 and 32.6 of 6, 8 and 10 % of charcoal, respectively. But of dilutions of (400) and (500) g/l were recorded (30.03, 29.24 and 27.93%) and (28.83, 27.06 and 26.13%) of 6, 8 and 10% of charcoal, respectively. The results present in table (5) showed that clarification slightly increased the sugar losses in molasses of the first dilution of 300 g/l. But clarification greatly increased sugar losses in wastes in other of two dilutions of 400 and 500 g /l. This result was lower than that obtained by **Mohamed (1966)** on the same dilution (300 g/l) using charcoal of 15, 18 and 21 % the results were 24.2, 26.5 and 28.7 %; respectively, high results due to use high concentrations of charcoal.

The results present in table (5) showed that clarification slightly reduced the reducing sugar recovery in diluted molasses solution. At the first dilution of molasses (300 g/l) were 18.22, 17.73 and 17.3 of 6, 8 and 10 % of charcoal, respectively. But of dilutions of 400 and 500 g/l were ranged between (17.25, 15.92 and 14.32) and (16.04, 14.71 and 13.4) of 6, 8 and 10% of charcoal; respectively.

The results in table (5) showed that clarification slightly increased the reducing sugars in molasses of the first dilution of 300 g /l. But clarification greatly increased reducing sugars in wastes in other of two dilutions of 400 and 500 g/l. The chemical composition of sugar cane molasses is presented in Table (5). The molasses contained 18.22% reducing sugars, 35.1% sucrose and 53.32% total sugars reported by **(Paturau, 1989).** Results indicated that chemical composition of sugar cane molasses were in close agreement to those reported by **(Chen and Chou, 1993)** who found that molasses contained 52% total sugars, 16% reducing sugars and 34% sucrose. Total sugars were in descending rate with increasing of molasses dilution and charcoal.

Table (5): Effect of charcoal levels on reducing sugar, sucrose and total sugars of diluted sugar cane molasses:

diluted molasses gm/l	original charcoal			reducing sugar, sucrose and total sugars /100gm molasses								
				6			**8**			**10**		
	R.S	Suc	T.S	R.S.	Suc.	T.S.	R.S.	Suc.	T.S.	R.S.	Suc.	T.S.
300	19.20	36.63	57.79	18.22	35.1	53.32	17.73	34.07	51.8	17.3	32.6	49.9
400	19.20	36.63	57.79	17.25	30.03	47.28	15.92	29.24	45.16	14.32	27.93	42.25
500	19.20	36.63	57.79	16.04	28.83	44.87	14.71	27.06	41.77	13.4	26.13	39.53

R.S = reducing sugar Suc = sucrose T.S = total sugars

From the previous data it could be recommended to use dilution molasses 300 g/l with 10 % charcoal to produce good clarified molasses using in food processing as cake , meat and high fructose syrup…..etc.

Conclusion

The best solution of sugar cane molasses dilution was 300 g/l and 10% charcoal because it was gave a higher rates level of sucrose and reducing sugar and very lower rates level of ash and color than those in other concentration diluted molasses and charcoal.

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