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Development of granular jaggery and jaggery based chocolates

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Abstract
Jaggery is a natural sweetener made by concentrating the sugarcane (*Saccharum officinarum*) juice with clarification to remove impurities and uniform heating in open pan. It is a sensitive product, getting affected by number of factors right from cultivation practices of sugarcane to processing and storage. The present study implies that the development of granular jaggery which can be used to replace the utilization of sugar granules in daily intake and comparative study on processed jaggery products with sugar products. The granular jaggery were prepared by concentrating sugarcane juice of above 20 ^{o}brix and uniform heating up to 120 ^{o}C in an open pan and scrapping the gur with wooden scrapper. Granular jaggery of less than 2 mm size were prepared by sieving and packed in polythene pouches. These jaggery granules were used to prepare jaggery chocolates and compared with sugar-based chocolates which is taken as control sample, S_o. The jaggery chocolates were formulated by using different proportion of granular jaggery i.e., 45, 50, and 55 per cent for J_1, J_2 and J_3 samples respectively. During the study, proximate analysis and sensory evaluation were conducted for J_1, J_2, J_3 and S_o samples to find the acceptance level of the jaggery chocolates using standard methods. The formulated jaggery chocolates with 50 per cent granular jaggery i.e., J_2 sample were acceptable with good flavour and textural properties.

Keywords: Granular jaggery chocolates, sugar-based chocolates, chemical analysis, nutritional composition and sensory-evaluation

Introduction
Jaggery (Gur) is a natural, traditional sweetener made by theconcentration of sugarcane (*Saccharum officinarum*) juice and is known all over the world indifferent local names Gur in India, Desi in Pakistan, Panelain Mexico and South America, Jaggery in Burma and African countries, Hakuruin Sri Lanka and Naam Taanoiin Thailand (Thakur, 1999).The Worldwide production of sugarcane is around 1161.5 Million tonnes. Out of total world production, more than 70% is produced in India. InIndia 300 Million tonnes of sugarcane produced, 53% is processed into white sugar, 36%intojaggery and khandsari, 3% for chewing as cane juice, and 8% as seed cane. The present production of sugar and jaggery in India are 27.7and 6.6million metric tonnes, respectively (Sugar Production Annual Report, USDA 2017). Jaggery is important in Indian diet, which is consumed either directly or used in preparation of various sweet based foods (Verma *et al.*1990).
Jaggery is generally called as ‘‘medicinal sugar’’ because of its use in Ayurveda as well as its comparison with honey (APEDA, 2016).Jaggery is among major agro processing industries in India. Nearly 20-30% of total sugarcane produced in the country is used for manufacture of about 7 million tonnes jaggery, which is known as most nutritious agent among all sweeteners (Madan *et al*. 2004).
It is therefore, imperative to expand the sector, as it provides higher food value jaggery at lower cost and boosts-up the rural economic system, involves low transportation cost of raw material, and non-requirement of highly technical machinery and labour (Ali, 2008.)

Material and Methods
Raw materials and Ingredients
Main raw material sugarcane stems were purchased from Regional Sugarcane and Rice Research Station, Rudrur, to prepare granular jaggery. Ingredients like granular jaggery, sugar, cocoa powder, cocoa butter, whole milk powder and Aonla were used in the preparation of jaggery chocolates.

Processing Equipments

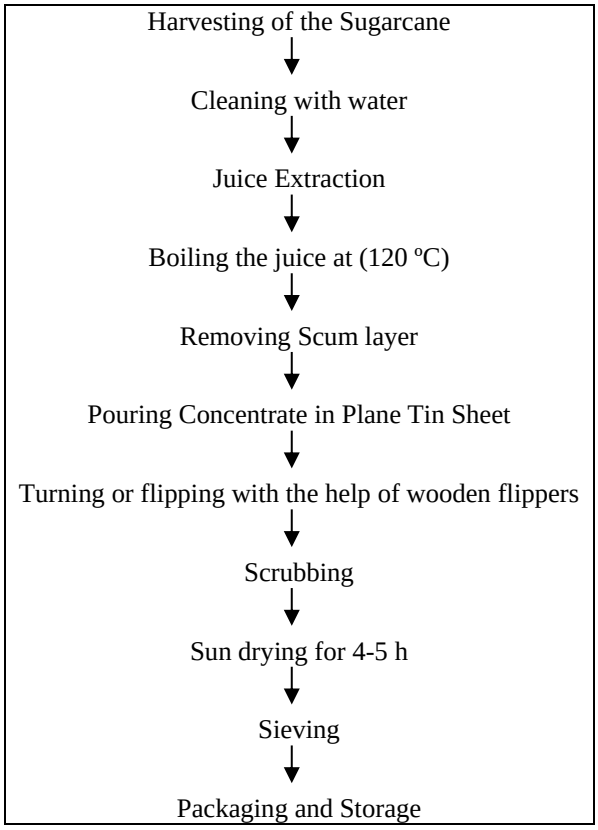
Equipments such as sugarcane crusher, refractometer, thermometer, sieve shaker, grinder, chocolate moulds, microwave oven, soxhlet apparatus, muffle furnace and other equipments present in Food Technology Laboratory and Food Engineering laboratory, in College of Food Science and Technology, Rudrur.

Methodology for Preparation of Granular Jaggery and Jaggery Chocolates

Preparation of Granular Jaggery

The process of making granular jaggery is similar up to concentration. The concentrating slurry is rubbed with wooden scrapper, for formation of grains. The granular jaggery is then cooled and sieved. Less than 3 mm sized crystals are found to be better for quality granular jaggery and striking point temperature of 120 °C was found to yield quality granular jaggery with high sucrose content of 88.6%, low moisture of 1.65%, with good colour, friability and crystallinity. Jaggery in the form of granules (sieved to about 2 mm), sun dried and moisture content reduced to less than 3%, and packed in polyethylene polyester bags or polyethylene bottles, can be stored for longer time. (Anonymous 2014).

Colour of jaggery granules or powder can range from golden yellow to golden brown and dark brown like dark chocolate. The colour is often dependent on base ingredient used to make jaggery powder. It is softer than sugar and also amorphous. This is because vitamins proteins and ingredients of cane are not removed. The preparation of granular jaggery is shown in flow sheet 1 as described below.



Flow sheet 1: Preparation of granular jaggery

Plate 1: Juice extraction

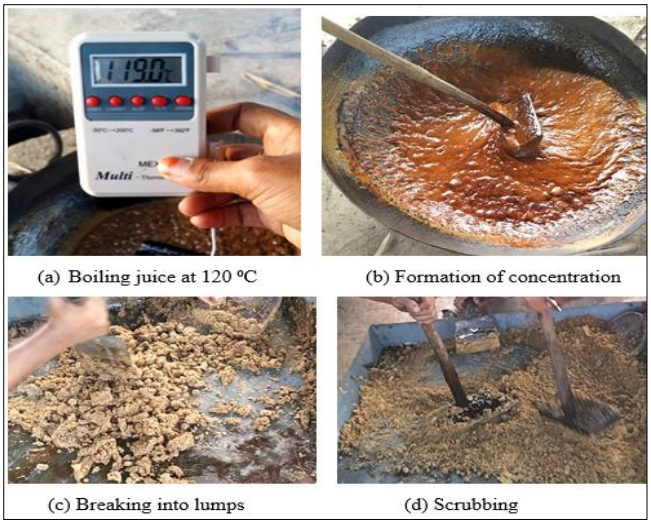


Plate 2: Processing of granules

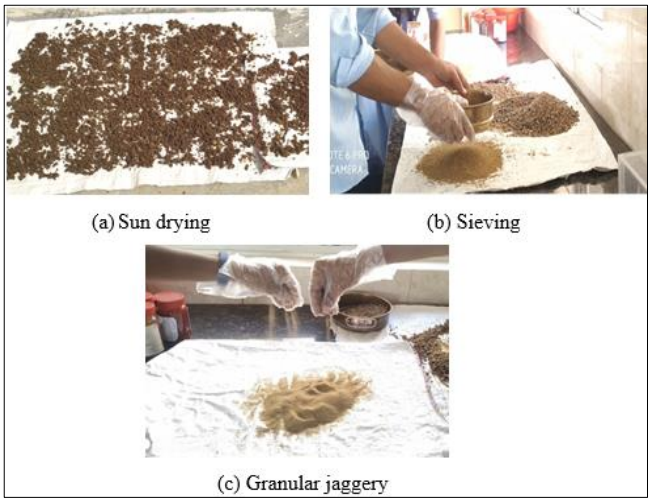
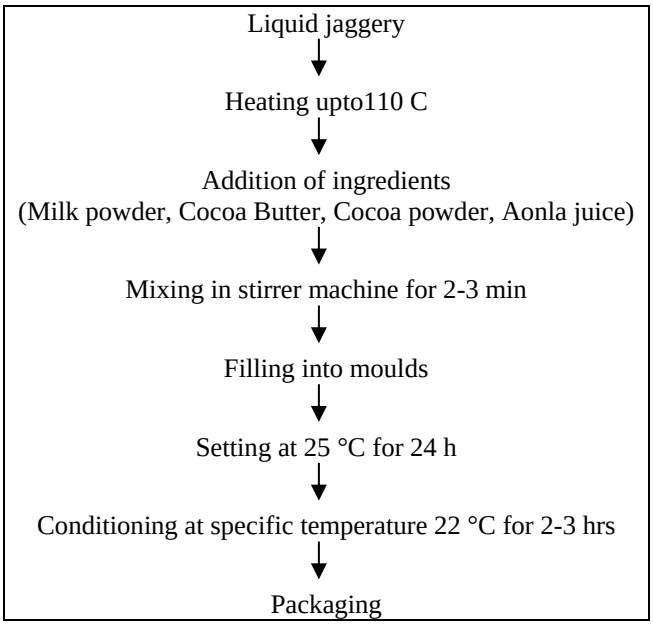


Plate 3: Sieving of granules

Preparation of Jaggery Chocolates

The jaggery chocolate was prepared by the method as described by Kedari (2005). The fresh liquid jaggery was heated in an iron pan at 110ºC for 10 min. All the ingredients were added to it and mixed with the help of a glass rod. The contents were mixed for 2–3 min on a stirrer at 80 rpm. The chocolate moulds were prepared by applying a thin layer of melted butter on its surface so that the chocolate did not stuck to the moulds and could be easily removed. The chocolate mix was poured in the moulds and allowed to cool until it got set. The chocolates were kept for 24 h for setting at an ambient temperature. The chocolates were removed from the moulds and kept for conditioning for at room temperature. The preparation of jaggery chocolates were shown in the flow sheet 2 as described below.



Flow sheet 2: Preparation of jaggery chocolates

Plate 4: Jaggery chocolate

Different Formulation for Jaggery Chocolate

To standardize the jaggery chocolates three formulations are taken namely J1, J2, J3 were assumed and it is compared with the standard sugar sample S_o. The proportion of raw materials and other ingredients used for formulation of jaggery chocolates are given in table 1.

Table 1: Different formulation for jaggery chocolate

S. No.	Ingredients		Formulation		
		S_o	J1	J2	J3
1	Sugar	45	-	-	-
2	Granular jaggery	-	45	50	55
3	Cocoa powder	25	25	20	15
4	Cocoa butter	15	13	13	13
5	Milk powder	15	15	15	15
6	Aonla Juice Extract	-	2	2	2

S_o- Sugar control sample
J1-Jaggery chocolate sample with 45% granular jaggery
J2-Jaggery chocolate sample with 50% granular jaggery
J3-Jaggery chocolate sample with 55% granular jaggery

Analysis of chemical properties

The chemical properties like moisture, fat, protein, ash and carbohydrate were analyzed by using standard analytical procedures given by AOAC, International 1990.

Moisture content

Moisture content was estimated adopting AOAC (1990) method. The following equation was used to measure moisture content.

$$\% \text{ Moisture} = \frac{W2-W3}{W2-w1} \text{x } 100$$

Were,
W_1=Weight of the container with lid, g
W_2=Weight of the sample before drying +weight of the container with lid, g
W_3=Weight of the sample after drying+ weight of the container with lid, g

Ash Content
AOAC (1990) method using muffle furnace was used to determined ash content of the samples. The per cent ash was calculated using following formula.

$$\text{Ash content (\%)} = \frac{W3-W2}{W1} \text{x} 100$$

Where,
W_1= Weight of the sample, g
W_2= Weight of the crucible before combustion, g
W_3=Weight of the crucible after combustion, g

Protein content
Protein content was determined using AOAC (1990) method. The percentage of nitrogen and protein were calculated by the following equation.

$$\text{Protein (\%)} = \frac{Ts-TbxNornalityofacidxmeq.ofN2}{Weightofsample\ (g)}$$

TS = Titre volume of the sample, ml Tb = Titre volume of Blank, ml
Meq. of N2 = 0.014 and
% Protein = Nitrogen× 5.7

Fat content
AOAC (1990) method using Soxhlet apparatus was used to determined crude fat content of the samples. The percent of crude fat was expressed as follows

$$\text{Fat content (\%)} = \frac{\text{Final Weight of flask}}{\text{Intital weight of flask}} \text{x} 100$$

Total carbohydrate
Total carbohydrate content of the samples was determined as total carbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 (Pearson,1976).

% Carbohydrate =100- (% Moisture +% Ash +%Fat + % Protein)

Results and Discussion
The parameters like moisture content, protein content, ash content, fat content and carbohydrates were evaluated for granular jaggery and presented in the table 2.

Table 2: Proximate composition of granular jaggery

S. No.	Parameter (%)	Mean ± Standard deviation
1	Moisture	1.92 ±0.03
2	Ash	2.45 ±0.30
3	Protein	0.65 ±0.06
4	Fat	1.07 ±0.15
5	Carbohydrates	94.08 ±0.36

Similarly, oisture content, protein content, ash content, fat content and carbohydrates were evaluated for both jaggery chocolates and sugar chocolates. From the results given below it was observed that the nutritional composition of the jaggery based chocolates were shown high protein and ash content (Mineral content) when compared with sugar-based chocolates.

Table 3: Proximate composition of jaggery chocolates and sugar-based chocolates

S. No.	Parameter (%)	Mean ± Standard deviation			
		S_o	J_1	J_2	J_3
1	Moisture	10.36 ±0.31	9.27 ±0.32	7.28 ±0.36	7.81 ±0.23
2	Ash	0.32 ±0.05	0.14 ±0.051	0.063 ±0.030	0.063 ±0.05
3	Protein	14.49 ±0.61	15.56 ±0.46	15.72 ±0.08	14.47 ±1.31
4	Fat	17.71 ±0.27	17.10 ±0.09	14.64 ±0.15	18.54 ±0.35
5	Carbohydrates	56.26 ±0.71	58.05 ± 0.27	61.88 ±0.40	56.88 ± 1.58

It was observed that the highest moisture content of chocolates recorded for sample S_o is 10.36% whereas the lowest value recorded for sample J_2 is 7.28%. The highest fat content was found in J_3 18.54% and whereas the lowest was recorded in J_2 is 14.64%. The highest Protein content was observed in J_2 is 15.72% whereas the lowest was observed in J_3 is 14.47%.

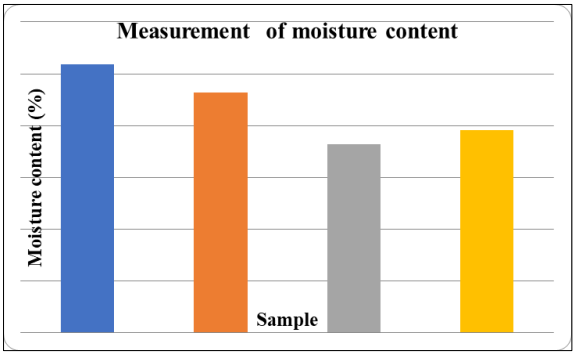


Fig 1: Estimation moisture in jaggery of chocolates

It was found that the moisture content in the sugar sample S_o is comparative higher i.e. 10.36 per cent when compared with jaggery chocolates. Changes in the ingredients proportion during formulation of chocolate resulted in high moisture in sugar sample. The moisture percentage of J_2 sample i.e. 7.28 per cent were found to be under same range as reported by the Chand *et al*. (2011).

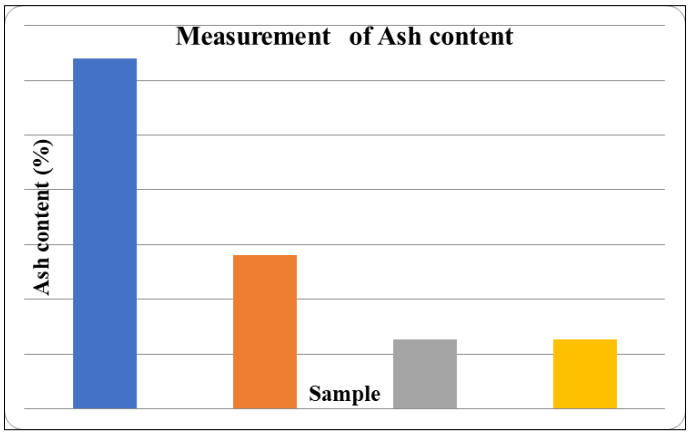


Fig 2: Estimation of ash content in jaggery chocolates

Ash is an indication of mineral contents of foods. From the figure 4.7 it was observed that the ash content of jaggery chocolates is comparatively higher than sugar-based chocolates due to high mineral composition of jaggery as described by the Singh *et al.* (2013).

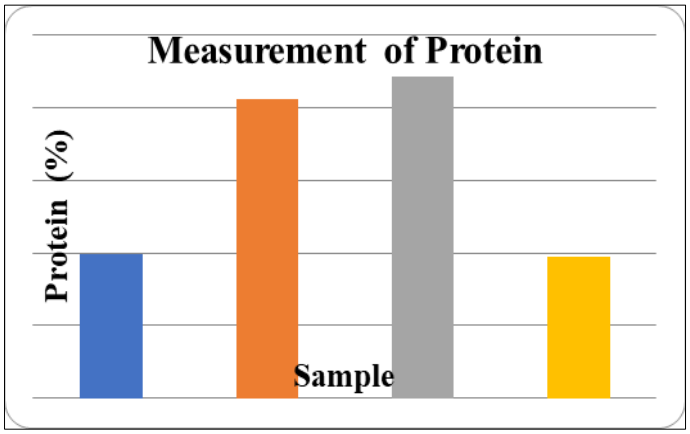


Fig 3: Estimation of protein in jaggery chocolates

From the figure 3, it was observed that the variation in the cocoa powder composition during formulation of jaggery based chocolates resulted in high protein content of J2 sample when compared with sugar sample.

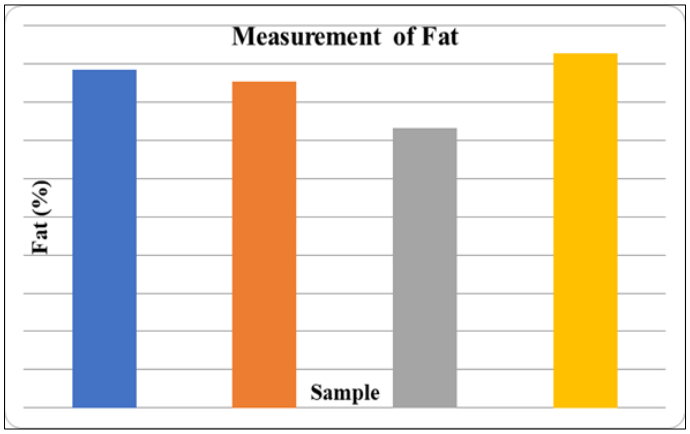


Fig 4: Estimation of fat in jaggery chocolates

From the figure 4, it can be observed that the fat content of the J2 sample 14.64 per cent is comparatively lower when compared with sugar sample S_o i.e., 17.71. Low fat content in jaggery sample was obtained due to variation in the cocoa powder during formulation of chocolates.

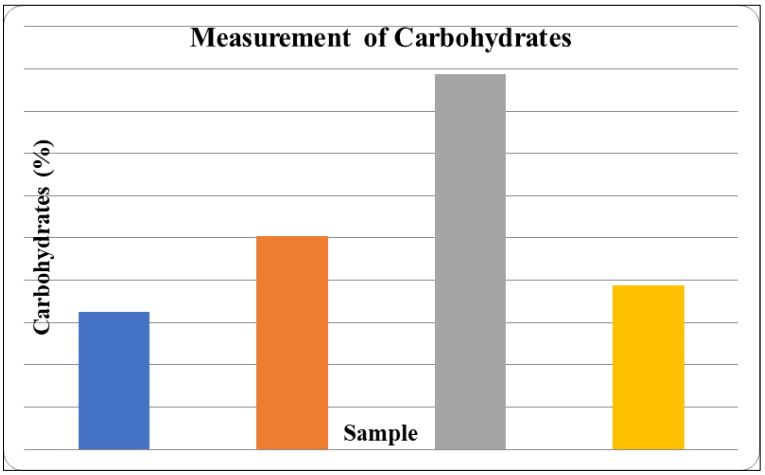


Fig 5: Estimation of carbohydrates in jaggery chocolates

From the figure 5, it can be observed that carbohydrate content of J_2 sample 61.88 per cent scored higher when compared with sugar sample S_o i.e., 56.26 per cent. Since jaggery is rich source of carbohydrate when compared with empty calories in sugar, high carbohydrate content was found in jaggery based chocolates.

Organoleptic evaluation of jaggery chocolates

Sensory evaluation acceptance tests were performed for jaggery chocolates. Which were formulated by addition of granular jaggery, cocoa powder in different proportions to know the acceptability of products prepared. The acceptance scores were assigning for varies sensory parameter like color, flavor, taste, texture, appearance and overall acceptability.

Table 4: Organoleptic evaluation of jaggery chocolates

S. No	Parameter	S_o	J_1	J_2	J_3
1	Colour	7.8	8.0	8.5	7.4
2	Flavor	7.2	7.6	8.2	7
3	Texture	7	7.6	7.9	7.5
4	Appearance	7	7.2	8.1	7
5	Overall acceptability	7	7.6	8.2	6.8

Where,
S_o- with 50% of sugar
J_1- with 45% of granular jaggery
J_2- with 50%of granular jaggery
J_3- with 55% of granular jaggery

It was observed that the highest overall acceptability score was awarded for sample J_2 8.2 because it got acceptable results in color, flavor, texture, appearance, whereas lowest value 6.8 received for sample J_3. The next parameter i.e., color, serve as important parameter for the acceptance of food samples. The highest score found in sample J_2 8.2 because of its acceptable color whereas the lowest score was observed for the sample J_3 6.8. The appearance of sample J_2 was significantly superior to the other samples. In texture profile the highest score was observed in J_2sample. The lowest for sample J3. The highest value of flavor obtained for the $J_2$and the lowest for the sample J_3.

Conclusion

From the study it can be conclude that jaggery granules were developed by heating the sugarcane juice of 20 ºbrix at a temperature of 118 ºC to 120 ºC. The jaggery chocolates can be formulated easily and can be consumed as value added food product. Nutritional composition of the jaggery chocolates in every analyzed parameter is higher when compared with sugar-based chocolates which is health beneficial to consume it as food product with good source of minerals and vitamins as described by Rajesh *et al.* (2016).

References

1. Ali N. Industrial and policy issues of jaggery industry in India, 2008.
2. Gartaula G, Bhattarai M. Replacement of sugar in the product formulation of Bomboyson by jaggery. Food Science & Nutrition, 2014;2:521-5.
3. Kedari S, Ramesh. Selection of level of ingredients in jaggery chocolate using response surface methodology. M.Tech. Thesis, GBPUA&T., Pantnagar, 2005.
4. Madan HK, Jaiswal UK, Kumar J, Sand Khanna SK. Improvement in gur (jaggery) making plant for rural areas. Journal of Rural Technology. 2004;1:194-196.
5. Madaria PB, Rao KJ. A study on utilization of whey in jaggery production. Sugar Technology. 2012;14(3):295-303.
6. Rajesh CK, Shajahan MA, Shahul Hameed A. Ayurvedic review on Guda (Jaggery). Ayurpharm International Journal of Ayurvedic Allied Science. 2016;5(5):68-76.
7. Rao PVK, Das M, Das SK. Jaggery- A traditional Indian sweetener. Indian Journal of Traditional Knowledge. 2007;6(1):95-102.
8. Thakur AK. Potential of jaggery (Gur) manufacturing in Punjab state. Proceedings of the National Seminar on Status, Problems and Prospects of Jaggery and Khandsari Industry in India. Indian Institute of Sugarcane Research. Lucknow, India. 1999.
9. Verma VK, Narain M. Moisture absorption isotherms of jaggery. Jaggery Storage Period. 1990;26:6146-6147.