

Prosthetic Application of Newly Experimental Modeling Wax with some Additives (Medical Grass Extract)

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الخلاصة

الاهداف: تهدف الدراسة الى تحضير شمع قاعدة طقم تجريبي جديد مكون من البارافين الصلب ، شمع النحل ،النشأ وخالصة اعشاب طبية (زيت الزيتون) ودراسة التمدد الحراري الخطي ودرجة الانصهار للشمع المحضر . **المواد وطرق البحث :** تم تحضير النماذج (30 نموذج) عن طريق خلط شموع عراقية طبيعية (البارافين الصلب وشمع العسل) مع اضافات طبيعية (النشأ و زيت الزيتون) بنسب مئوية محددة ضمن هذه الدراسة وتم استخدام قالب محضر طبقا لمواصفات الجمعية الامريكية لطب الاسنان رقم(24) وبعد ذلك تم قياس درجة الانصهار والتمدد الحراري الخطي للنماذج المحضرة ومقارنتها مع شمع قاعدة طقم تجاري (SHANGCHI) النتائج : أظهرت النتائج ان شمع قاعدة الطقم التجريبي الجديد (1) (80% بارافين صلب + 15% شمع العسل + 5% زيت الزيتون) يمتلك درجة انصهار (°C 59.8 - 63.6) مقارنة لشمع قاعدة الطقم التجاري (°C 58 - 63.4) وان شمع قاعدة الطقم التجريبي (2) (90% شمع العسل + 5% زيت الزيتون) يمتلك تمدد حراري خطي (0.186%) مقارب الى شمع قاعدة الطقم التجاري (0.204%). **الاستنتاجات :** ان اضافة زيت الزيتون الى شمع قاعدة الطقم التجريبي (1) (80% بارافين صلب + 15% شمع العسل + 5% زيت الزيتون) ادى الى زيادة التمدد الحراري الخطي وتقليل درجة الانصهار ، اما اضافة زيت الزيتون الى شمع قاعدة الطقم التجريبي (2) (90% شمع العسل + 5% نشأ + 5% زيت الزيتون) ادى الى تقليل درجة الانصهار والتمدد الحراري الخطي.

ABSTRACT

Aims of the study: preparation of a new experimental modeling wax from hard paraffin, beeswax, starch, and medical Grass Extract (olive oil) and study the linear thermal expansion and melting point properties of the prepared wax. **Materials and Methods :** The samples were prepared (30 samples) by mixing Iraqi natural waxes (hard paraffin and beeswax) with additives (starch and olive oil) using special percentages proportions determined according to this study and using mold prepared according to ADA specification No.24, and the melting range and thermal expansion of these samples measured then compared with commercial modeling wax (SHANGCHI). **Results:** The new experimental modeling wax 1 (80% hard paraffin + 15% beeswax + 5% olive oil) have minimum and maximum melting point mean value (59.8 – 63.6 °c) near to control (commercial modeling wax) (58 -63.4 °c) and the new experimental modeling wax 2 (90% beeswax + 5% starch + 5% olive oil) have linear thermal expansion mean value (0.186%) near to control (SHANGCHI) (commercial modeling wax) (0.204%). **Conclusions :** The addition of olive oil to new experimental modeling wax 1(80% hard paraffin + 15% beeswax + 5% olive oil) lead to increase the linear thermal expansion and reduce the melting point, and the addition of olive oil to new experimental modeling wax 2 (90% beeswax + 5% starch + 5% olive oil) lead to decrease thermal expansion and reduce melting point.

Keywords: modeling wax, medical Grass Extract, prosthetic application

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INTRODUCTION

The majority of modelling waxes used in dentistry are combination of paraffin wax and beeswax together with small addition of other natural waxes, synthetic waxes and coloring agents⁽¹⁾. The olive oil

used in dentistry in the treatment of xerostomia or dry mouth^(2,3), in the treatment of periodontal abscess⁽⁴⁾, relieving of dental pain⁽⁵⁾ and used as a substitute for cold mold seal (alginate mold seal) in the process of curing of cold-cure acrylic resin

against plaster ⁽⁶⁾. Base plate waxes may contain 70 % to 80 % paraffin-base waxes or commercial ceresin, with small quantities of other waxes, resin and additives wax ^(7,8). With complicated component, waxes have a melting range rather than a single, sharp melting temperature ^(9,10), because these waxes contain several types of molecules, each having a range of molecular weights ^(11,12). Waxes used in dentistry may be composed of natural and synthetic waxes ⁽¹³⁾, gums, fats, fatty acid, oils, natural synthetic resin, and pigment of various types ⁽¹⁴⁾. The purpose of this study was to prepare a new experimental modelling wax from medical grass extract and study linear thermal expansion and melting range.

MATERIALS AND METHODS

The first new experimental modeling wax was prepared from (80% hard paraffin + 15% beeswax + 5% olive oil) and the new second experimental modeling wax prepared from (90% beeswax + 5% starch

+ 5% olive oil). The physical properties of the two experimental modeling waxes were evaluated by measuring the melting range and linear thermal expansion according to ADA specification no. 24 and compared with control (commercial modeling wax) (SHANGCHI, China).

Linear Thermal Expansion:

The total number of samples (80% hard paraffin +15% beeswax +5% olive oil) and (90% beeswax + 5% starch + 5% olive oil) are thirty (30) with dimensions (305 ± 0.1) mm length, (22.2 ± 0.1)mm width, and (14.3 ± 0.1) mm height). A quantity of wax was broken into small pieces and placed in a metal pouring pan. The pan was then placed in water bath and the wax starts to melt and becomes fluid, the wax reaches (75 ± 5) °C was maintained at this temperature until pouring into mold ⁽¹⁵⁾. The melted wax was then poured into a mold that has been lubricated with separating medium (separating film for acrylic resin) (Figure1).



Figure (1):The mold was lubricated with separating medium

The mold was preheated to (55 ± 5) °C. The Aluminum cover preheated to (55 ± 5) °C was placed on the top of the mold, then a weight of 90N (9kg) is placed on the top of the mold for 30 min, after that the

weight and cover were removed and excess wax trimmed away and the specimen was stored at room temperature (20 ± 2) °C for 24 hours before testing, (Figure 2).



Figure(2): The wax specimen was stored at room temperature

The specimen was heated to 25 °C and 40 °C and the distance between the reference marks at the lower temperature and the change in length on heating to higher temperature was determined. The wax specimen was placed under the holder and

the reference marks pass through the openings of the holder. The distance between the reference marks was determined to the nearest 0.01 mm. The electronic digital caliper was use make the measurement (Figure 3).

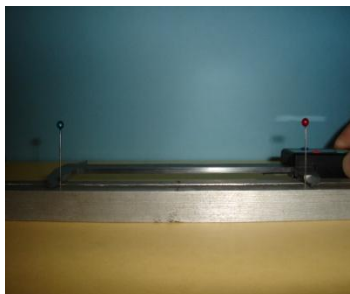


Figure (3): The distance between reference marks was measured by using digital caliper

An initial measurement was made in water after 20 min at (25 ± 0.1) °C. The 25°C temperature was used as zero point. The temperature is then raised in water bath to (40 ± 0.1) °C. The specimen remains 20 min at that temperature before the distance between reference marks was determined. Three measurements for each sample were obtained and the mean of these measurements was calculated. The change in length was measured and the thermal expansion is calculated as percentage of the total length of specimen ⁽¹⁶⁾.

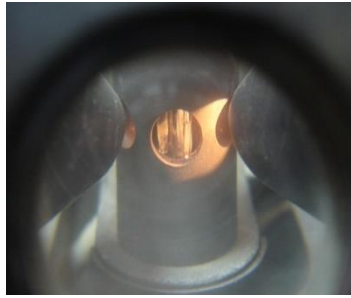
Melting Range: The melting point was measured according to method reported by Vogel ⁽¹⁷⁾, using Electrothermal melting point apparatus (CE, VWR, INTERNATIONAL): About 0.1 gm of wax is inserted through the opened end of capillary tube with gentle tabbing of the capillary tube until the material reaches the closed end of the capillary tube. The procedure was repeated until the length of lightly packed material is 5 mm. The filled capillary tube is placed inside the Electrothermal melting point apparatus (Figure 4).



Figure(4): The filled capillary tube was placed inside Electrothermal melting point Apparatus

Then starts by switching-on the apparatus and watching the wax inside the capillary tube through the magnifier of the ap-

paratus, at the same time the temperature in the thermometer was watched also until wax starts to melt (Figure 5).



Figure(5): Wax starts to melt

This point consider the beginning point of the melting range, and continue watching the wax through the magnifier until become completely fluid, and this consider the ending point of the melting range.

RESULTS

The number of samples, minimum, maximum, mean and standard deviation of linear thermal expansion of new experimental modeling wax (1) ,(2) and control (SHANGCHI) are listed in Table (1).

Table (1): Descriptive statistics for thermal expansion of new experimental modeling wax (1) ,(2) and control

Group	N	Minimum %	Maximum%	Mean %	SD
Control (SHANGCHI)	5	0.18	0.22	0.204	0.1817
Exp. 1	5	0.31	0.43	0.348	0.497
Exp. 2	5	0.17	0.21	0.186	0.1517

N: number of samples SD: standard deviation

Exp. 1 : (80% hard paraffin + 15% beeswax + 5% olive oil)

Exp. 2 : (90% beeswax + 5% starch + 5% olive oil)

The analysis of variance (ANOVA) of linear thermal expansion of new experiment

tal modeling wax (1) , (2) and control (SHANGCHI) are shown in Table (2).

Table (2): The analysis of variance (ANOVA) of the thermal expansion of new experimental modeling wax (1) , (2) and control

	SS	df	MSE	F	p-value
Between groups	0.079	2	0.039	39.030	0.000
Within groups	0.012	12	0.001		
total	0.091	14			

SS: sum of squares df: degree of freedom MSE: mean square

The number of samples, minimum, maximum, mean and standard deviation of minimum and maximum melting point of

new experimental modeling wax (1) , (2) and control (SHANGCHI) are listed in Tables (3,4).

Table (3): Descriptive statistics for minimum melting point of new experimental modeling wax (1) ,(2) and control

Group	N	Minimum (°c)	Maximum(°c)	Mean (°c)	SD
Control (SHANGCHI)	5	57	59	58	0.707
Exp. 1	5	59	60	59.8	0.447
Exp. 2	5	61	62	61.4	0.548

N: number of samples SD: standard deviation
 Exp. 1 : (80% hard paraffin + 15% beeswax + 5% olive oil)
 Exp. 2 : (90% beeswax + 5% starch + 5% olive oil)

Table (4): Descriptive statistics for maximum melting point of new experimental modeling wax (1) ,(2) and control

Group	N	Minimum (°c)	Maximum(°c)	Mean (°c)	SD
Control (SHANGCHI)	5	63	64	63.4	0.707
Exp. 1	5	63	65	63.6	0.447
Exp. 2	5	69	71	70.2	0.548

N: number of samples SD: standard deviation
 Exp. 1 : (80% hard paraffin + 15% beeswax + 5% olive oil)
 Exp. 2 : (90% beeswax + 5% starch + 5% olive oil)

The analysis of variance (ANOVA) of minimum and maximum melting point of new experimental modeling wax (1) , (2) and control are shown in Tables (5,6).

Table (5): The analysis of variance (ANOVA) of minimum melting point of new experimental modeling wax (1) , (2) and control

	SS	df	MSE	F	p-value
Between groups	28.933	2	14.467	43.4	0.000
Within groups	4	12	0.333		
total	32.933	14			

SS: sum of squares df: degree of freedom MSE: mean squares

Table (6): The analysis of variance (ANOVA) of maximum melting point of new experimental modeling wax (1) , (2) and control

	SS	df	MSE	F	p-value
Between groups	149.733	2	74.867	124.778	0.000
Within groups	7.2	12	0.6		
total	156.933	14			

SS: sum of squares df: degree of freedom MSE: mean squares

Duncan's multiple range test of linear thermal expansion of control (SHANGCHI), new experimental modeling wax (1) & (2) show that the new experimental modeling wax 2 (90% hard paraffin + 5% starch +5%olive oil) have mean value near to control (Figure 6).

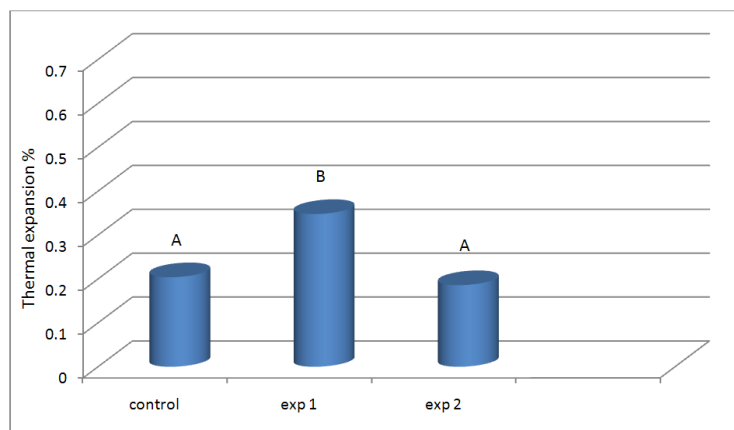


Figure (6) : Duncan's multiple range test of thermal expansion of control, exp 1, and exp 2

Duncan's multiple range test of minimum and maximum melting point of control (SHANGCHI), new experimental modeling wax 1 & 2 show that the new

experimental modeling wax 1 (80% hard paraffin + 15% beeswax + 5% olive oil) have minimum and maximum melting point near to control (Figures 7 , 8).

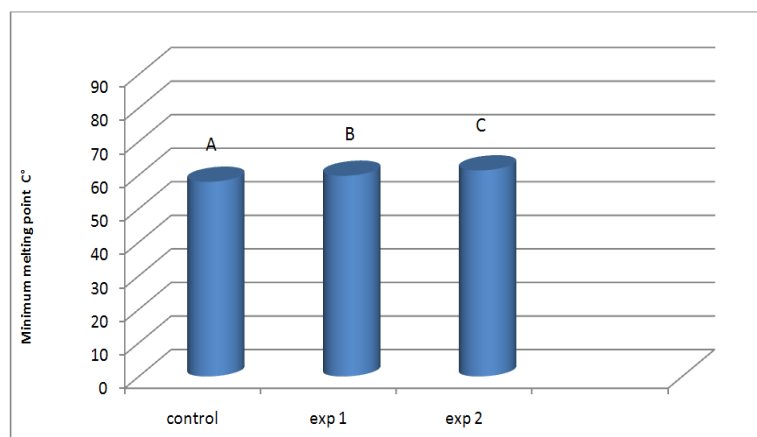


Figure (7) : Duncan's multiple range test of minimum melting point of control, exp 1, exp 2

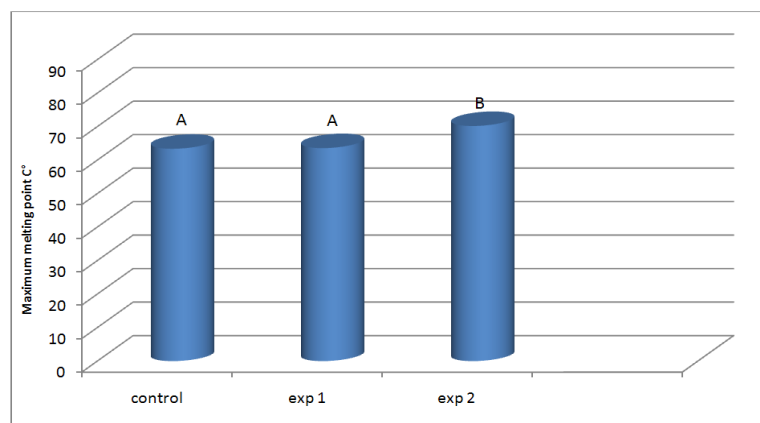


Figure (8) : Duncan's multiple range test of maximum melting point of control, exp 1, exp 2

DISCUSSION

The volumetric expansion provides information on how much a wax system is prone to distortion or deformation⁽¹⁸⁾. Table (1) and Figure (6) show that the new experimental modeling wax 1 (80% hard paraffin + 15% beeswax + 5% olive oil) having linear thermal expansion mean value higher than control (SHANGCHI), and this due to high percentage of hard paraffin and this agree with Craig⁽¹⁹⁾, who showed that the mineral waxes expand more because they have weak secondary valence forces, which overcome easily by energy absorbed during a rise in temperature. This permits more movement of the wax components, thus allowing a greater amount of thermal expansion^(7,12).

Table (1) and Figure (6) also show that the experimental modeling wax 2 (90% beeswax + 5% starch + 5% olive oil) have low thermal expansion and this due to high percentage of beeswax which has high secondary valence forces because of the presence of high concentration of esters. Since the secondary valence forces restrict the movement of wax component, small coefficient of thermal expansion are observed until the melting range of the wax is approached^(7,12), and this agree with Kooij et al⁽²⁰⁾, who stated that the beeswax is a very stable substance with lasting and constant properties. Also due to the presence of the starch which act as binding and thickening agents^(21,22,23).

Table (3), (4), Figure (7 & 8) show that the minimum and maximum melting point mean value of new experimental modeling wax 2 (90% beeswax + 5% starch + 5% olive oil) was higher than that of control (SHANGCHI) and new experimental modeling wax 1 and this due to the high percentage of beeswax and agree with Alubaidi,⁽²⁴⁾ who show that the beeswax had higher melting point than paraffin wax, this may refer to that the molecular weight of beeswax is higher than that of paraffin wax. These results are in agreement with McMillan and Darvell⁽²⁵⁾, who reported that the melting temperature generally increases with increasing molecular weight.

The results showed that all the tested samples had a melting range rather than a sharp melting point (Table 3 & 4). These results are in agreement with Craig (1989)

who revealed that the waxes have a melting range rather than melting point, this can be explained on the basis that the waxes are consist of similar types of molecules of different molecular weights and may contain several types of molecules each having a range of molecular weight.

CONCLUSIONS

The new experimental modeling wax 1 (80% hard paraffin + 15% beeswax + 5% olive) have minimum and maximum melting point mean value near to control (commercial modeling wax) (SHANGCHI) and the new experimental modeling wax 2 (90% beeswax + 5% starch + 5% olive oil) have thermal expansion mean value near to control (commercial modeling wax) (SHANGCHI), the addition of olive oil to new experimental modeling wax 1 (80% hard paraffin + 15% beeswax + 5% olive) lead to increase the thermal expansion and reduce the melting point, and the addition of olive oil to new experimental modeling wax 2 (90% beeswax + 5% starch + 5% olive oil) lead to decrease thermal expansion and reduce melting point so the new experimental modeling wax 2 is best than the new experimental modeling wax 1.

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