IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN (P): 2347–4580; ISSN (E): 2321–8851
Vol. 10, Issue 3, Mar 2022, 37–44

BIOTECHNOLOGICAL SYNTHESIS OF AN PROSTHESES DENTAL WAX, MODELING AND STICK

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Received: 26 Mar 2022 **Accepted:** 28 Mar 2022 **Published:** 29 Mar 2022

ABSTRACT

Our current research includes the manufacture of artificial wax used in the field of dentistry by biotechnological processes, in multiple steps and stages, as an application for a specialized scientific study within realistic experiments In the end, she gave two types of artificial tooth wax (modeling and stick wax). The mechanism of producing artificial dental wax included successive processes that included biotechnology and industrial technology. In biotechnology, the oil stored in the seeds of the flax plant has been extracted, and transformed raw material (semisolid 30gm), added to other components consisting of various types of wax taken from various sources (Paraffin Wax, Bees wax, Carnauba wax, Sericin (mineral) wax) with fixed standard weights (50gm, 10gm, 20gm, 20gm) respectively, so that all components are melted in the water bath to form the raw wax that will be pure and free of impurities and ready for use in the manufacturing process. The industrial technique includes melting (9% of the raw wax), which produced from biotechnology with fixed percentages of solidified and stick materials that help with viscosity. When 8% solidified and 2% stick materials added, modeling wax resulted, while when 2% solidified material sand 8% stick materials added, stick wax resulted.

KEYWORDS: *Biotechnology, Industrial Technology, Modeling Wax, Stick Wax*

INTRODUCTION

Biotechnology refers to many studies that lead to various discoveries that are utilized at present, and have entered into most fields of medicine and biology, as well as other related disciplines contributing to the development of industrial reality. Our current research is one of the applied research that leads to obtaining many Industrial products that make economic reality in a constantly renewed development with increasing research work. Dental wax is often made up of a combination of natural or synthetic ingredients, resins, oils or fats, as well as dyes and preservatives. The artificial dental wax has fixed specifications that may change due to various factors such as temperature, viscosity, and some mechanical factors such as applied pressure, leading to a change in its structural structure affected by stress (1). Wax is defined as a material made of thermoplastics that is usually solid at room temperature and soluble when exposed to heat without decomposing and not losing the nature of its properties, thus transforming into a moving liquid. Wax is mostly a soft material that has mechanical properties that enable it to change its shape permanently and has many uses in all fields, including dentistry, in addition to that it forms certain patterns according to the mold into which it will be poured. And this mechanical behavior depends on the temperature to which the wax is exposed at each stage of application (2).

There are many scientific processes for the production of many dental appliances, dentures or restorations, such as the production of a wax pattern of the appliance on the model. The wax pattern defines the shape and size of the resulting appliance and is eventually replaced by either a polymer or an alloy by using the (lost-wax technique). Methods involves the production of a model followed by the laying down of a wax pattern are known as (indirect techniques). Some dental restorations, such as inlays, may be produced by a direct wax pattern technique in which the inlay wax is adapted and shaped in the prepared cavity in the mouth of the patients. Waxes used in the production of patterns by either the direct or indirect technique must have very precisely controlled properties in order that well fitting restorations or appliances may be straighten. Other waxes used in dentistry field have less rigorous property requirements. One such material is used by manufacturers for attaching denture teeth to establish sheets (carding of wax). Another product used for boxing in impressions prior for the formation of gypsum model (boxing in wax). A third material is used for temporarily uniting two components of an appliance, for example, during welding (stick wax).While flow is important in every dental wax application, complicated by residue stress effects (3, 4), and thermal expansion, there exists no accurate flow specification, and no attempt has been made to characterize these materials rheological behavior. In spite of the urgent need for standardized testing methods being acknowledged as long ago as 1941 (5). Waxes are mentioned in only two of the international organization for calibration many standards, neither in a rheological situation. There is no other standardization work has been located in other fields. A specification based on a scientifically sound method is long delayed, despite the recognition of the importance of flow in wax applications (6).Controlling the weights and quantities of different types of wax and its multiple sources is important in obtaining the required specifications in the production of industrial wax used in the field of dentistry.

MATERIALS AND METHODS

Materials

(Magnetic stirrer, water path, mill (grinding device), flax seed, extraction chemical materials, standard sieves, raw wax from various sources, containers, burner, artificial dyes, solidified and stick materials, press divce, preservation materials, cutting machine, molds sizes (10/5 cm) for modeling wax, and (90/6 mm) for stick wax).

Methods

Extraction of Oil

Weigh 100 g of flaxseeds, then wash and dry, then grind them into small minutes in order to facilitate the extraction process, put them in a glass beaker, and add distilled water to it to complete it to (250 ml). Then the powder is placed in a magnetic stirrer for two hours, at a temperature of (50 C), in order to break the bond that connects the basic components of which the ground seed powder is composed. After the specified time has passed, we monitor the mixture and note that the entire amount of water used must evaporate in order for the oil we obtained to be pure, and filtered from the remaining impurities, then (1 gm) of sodium peroxide is added to it as a last step with continuous stirring for (10 minutes), as shown in **table no: 1**.

Mixing Processes

It is the process of mixing types of wax taken from various sources, including biological (plant and animal sources), and chemical (mineral and non-metallic sources), with the addition of the oil resulting from the extraction process. The quantities of wax selected in the manufacturing process shall be weighed according to the following specifications (7):

- Paraffin wax 50gm.
- Beeswax 10gm.
- Carnauba. wax 20gm.
- Sericin. (mineral) wax 20gm.
- Extracted Oil 30gm.

These materials were placed according to the mentioned weights in a glass beaker, and heated in a water bath, until the melting temperature completely, which ranges between (45-55 C), with monitoring that all the components are mixed and their homogeneity is stable, then it is left at a normal temperature between (25 - 30 C) to harden after (4 hours), as shown in **table no: 2**.

Industrial Process

The raw wax that was synthesized using bio-techniques was used within sequential steps with continuous follow-up and with fixed proportions and measurements recorded. The raw wax materials that have been synthesized are cheap commercial materials that are available in the local markets, and there is no difficulty in obtaining them. Solidified materials are added in proportions (8%), which is a greater percentage than the 2% viscous materials, in order to obtain industrial dental wax modeling wax type, but when manufacturing stick wax type , the mentioned percentages (solidified and stick materials) added to the raw wax are completely reversed, as shown in **figure no.1 and figure no.2**. Artificial dyes are added to the final mixture of wax that was produced according to the demand and needs of the commercial market. The common colors of industrial dental wax are often light and dark red, rose color, in addition to blue sometimes. Pigments are added gradually and evenly with continuous mixing to ensure homogeneous color distribution in the wax produced.

RESULTS

Table 1: To Illustrate the Oil Extracted by Biotechnological Processes

Type of Device	Material Used	Measurements	Final Product
Grinding Device	Flaxseeds	100gm	Powder
Magnetic Stirrer	Powder Product mixed with D.W.	250 ml	Colloidal Solution
Heater Device	Colloidal Solution Stirred with (1gm Sodium Peroxide).	250ml, at 50 C	Oil Extracted and Colloidal Materials.
Standard Sieves	Oil Extracted and Colloidal Materials.	150gm	(50gm) Semisolid Oil Extracted, Separated from the Colloidal Materials.

Table 2: To Illustrate Melting and Mixing Stage to form the Raw Wax

Quantities of Wax Obtained from Various Sources	Wax Weights Prepared for Melting
Paraffin Wax	50gm
Bees wax	10gm
Carnauba wax	20gm
Sericin (mineral) wax	20gm
Extracted Oil	30gm

Table 3: Percentage Components of Modeling Wax after Mixture of about 90% Raw Wax with (8% of Solidified, and 2% of Viscosity) Materials

Percentage Components of Modeling Wax	
Component	**Percentage**
Industrial (raw) wax	90%
Solidified Material	8%
Viscosity Material	2%

Table 4: Percentage Components of Stick Wax after Mixture of 90% Raw Wax with (2% of Solidified, and 8% of Viscosity) Materials

Percentage Components of Stick Wax	
Component	**Percentage**
Industrial (raw) wax	90%
Solidified Material	2%
Viscosity Material	8%

DISCUSSION

Our current research is considered one of the applied research that can be used in the production of artificial dental wax of its two types: Modeling and Stick wax. It is the result of a specialized scientific study that included the possibility of using biotechnology in the synthesis and production of these types of artificial dental wax. The principle of this synthesis mechanisms are based on the production of an artificial wax after a set of processes that included biotechnologies and industrial techniques, then processing it and changing some of its properties by adding solidified, and stick materials according to the type of wax to be produced. An artificial dental-waxes are thermoplastic modeling and stick materials which are solid in the same time at room-temperature (8).The powder of (100 g) of flaxseeds completed to (250 ml) in glass beaker with magnetic stirrer in order to separate of it components, and facilitate the oil extraction. The two hours, at a temperature of (50 C) were suitable conditions for break the chemical bond that connects the basic components of seed powder. Distilled water must be evaporate, and the remainder components are colloidal oil which then must be filtered from the remaining impurities, then (1 gm) of sodium peroxide was added with continuous stirring for (10 minutes), to perform the semi solidity of oil extracted in finally, as shown in **table no:1.** In the mixing stage, the materials were placed according to the mentioned weights in another glass beaker, and heated in a water bath, until the temperature of melting(45 - 55 C), at this temperature all wax's kinds that used are mixed, with homogeneity, to put prepared synthetic wax at a normal temperature (25 - 30 C), as shown in **table no:2**.Afterabout(4 hours), we obtained to the raw wax that ready to use in the synthesis and production of an artificial dental wax. This dental wax for both types of dentistry, (Wax used in carving, restoration and manufacture of teeth (Modeling Wax), which gives the structure of the mold to work on. Both modeling and stick wax that synthesized used by dentists and technicians. A lot of efforts were made to link the wax flow and flow when melting with the material structure, but they failed to know the complexity of wax formation and its structure with accuracy (9, 10). Stick Wax is less solid than the model, and it is used in the process of gluing the teeth and arranging them on plastic bases, as it represents the place on which the teeth are fixed while they are offered for sale after completing all the stages of manufacturing. There are a number of plant and animal extracts that can be used, and the active substances can be extracted by biological and chemical methods and techniques, and when mixed with a number of polymers involved in manufacturing, it leads to a change in the physical properties of dental wax, making it flexible on the one hand and strong on the other hand. , not subject to transformation.Therefore, in addition to the work of this extract material as an ingredient, it is at the same time a preservative, preserving the structural structure of the wax to be produced

and the two types we have mentioned above. This extract also helps to preserve all the chemical properties required in the wax to be manufactured in this study.Some attempts to study the process of flow and formation failed to clarify the properties of wax (11, 12). Because of the importance of the effect of the viscosity factor on dental wax, it has been proven that it is sensitive when the wax sample is subjected to pressure applied to it during use (13).

ARTIFICIAL DENTAL WAX PROPERTIES

The manufactured dental wax has multiple characteristics, the most important of which is related to the melting temperature and the transitional phase from one case to another, and the ability of the wax to soften and flexibility that depends on the temperature to which the dental wax is exposed during use in the installation of dentures or uses. The heat expansion characteristic of dental wax varies from one type to another according to the need, and this is an important factor that characterizes wax in general. The stability of the properties of dental wax is necessary to rely on it and the possibility of controlling it during use. The mechanical properties of dental wax are its fragility and vulnerability to temperature fluctuations to which the wax is exposed. What you should know is that dental wax has a stable crystalline structure characterized by a fixed melting point as well. The change in the crystalline structure of dental wax is accompanied by a change in the mechanical properties as well, which leads to the transformation of the wax from a brittle solid substance to a softer substance that can be molded in different ways, so the wax transition temperature that required transformation of the solid state to the softening state is called the softening point. The proportions of hardeners and viscous materials added to the raw wax entering the manufacturing process must be taken into account. High viscosity is undesirable if it exceeds the required limit. Also, the hardness should not increase or decrease below the required limit. In **figure (1) and (2)** the proportions of the main ingredients for each of the stick and modeling wax shown:

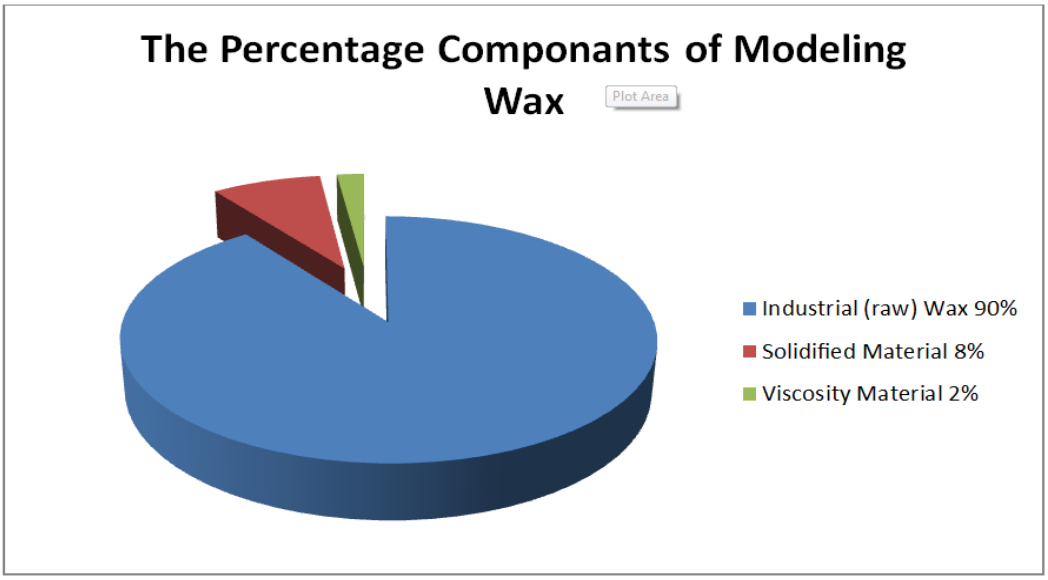

Figure 1: Shows Percentages of the Components When Manufacturing Modeling Wax, with a Solidified Content of 8% and Viscous Material 2%.

The process of manufacturing dental wax is the result of a series of experiments through which most of the product's characteristics are controlled and changed in order to obtain the ideal specifications that can be an alternative to the global commercial products available in the commercial markets. Therefore, we find that the proportion of hardeners and viscous materials added to raw wax Varying in both types of wax in which it was manufactured.

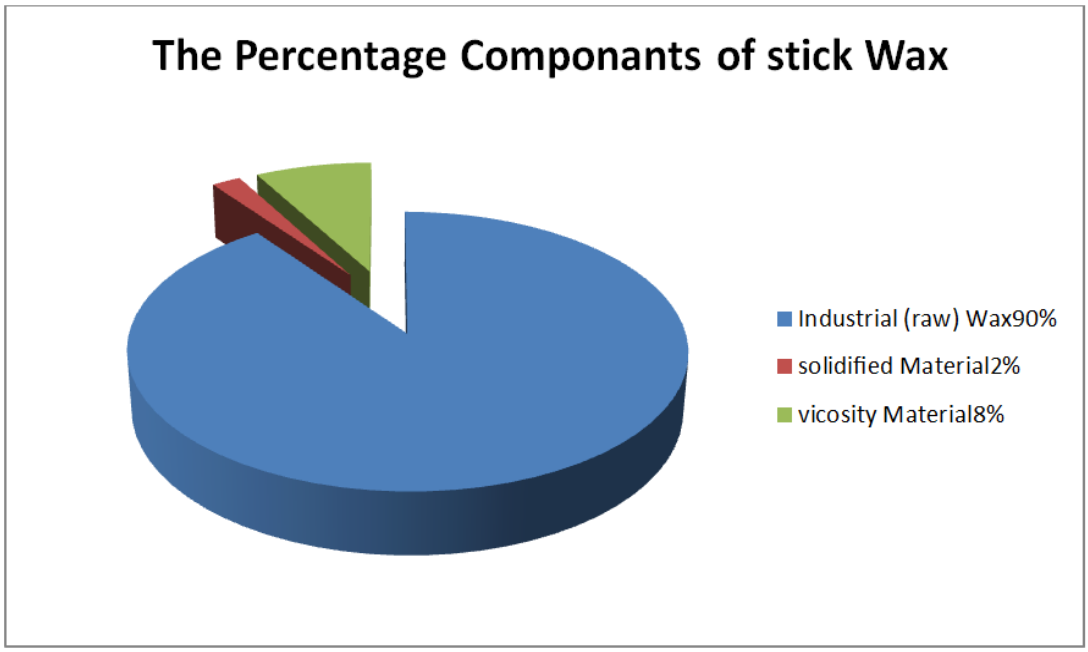

Figure 2: Shows Percentages of the Components When Manufacturing Stick Wax, with a Solidified Content of 2% and Viscous Material 8%.

The ratio of both hardened and viscous material in the total content of wax manufacturing is estimated at 10%, which is distributed in different proportions depending on the type of wax to be manufactured, whether type (modeling wax), or type (stick wax), as shown below in **figure (3)**.

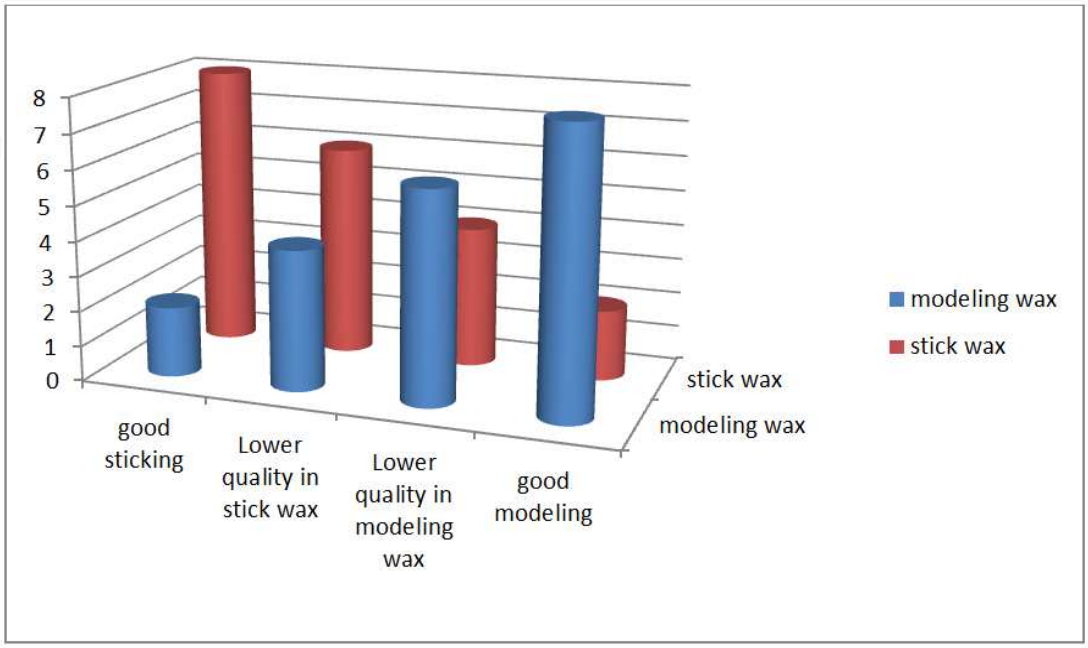

Figure 3: Schematic Representation to Show the Proportions of the Basic Components that Make Up Dental Wax.

After the manufacture of dental wax, which is of the model type, it is left to cool and during the cooling period it may often be subjected to possible shrinkage, and at this stage the product must be pressed with its own pistons to turn into a large slice that can be cut into small strips that are placed in nylon bags and cartons They are designed according to their

sizes. Dental waxes differs in almost properties and qualities like solidify, ductility and melting point (14). The manufactured dental wax may not shrink, but it may happen after the cooling period or later. Therefore, the pressing process is necessary to avoid shrinkage in any possible period of time. Therefore, the working conditions during the process of manufacturing dental wax must be within constant temperatures, and the product must be stored under temperatures not exceeding (35 C), and not less than (20 C).One of the most important properties that synthetic dental wax should possess is flexibility and ductility so that it is foldable during work, especially when exposed to a burner flame and warm water, because heating is the only way in which wax is used in the field of dentistry. Increasing the temperature through heating in warm water or exposure to a flame intended to soften the wax in an orderly manner may lead to the wax losing many of its basic properties and changing its main features, thus being unusable as it does not give the desired result when used. Sericin wax is a natural wax produced by the process of distillation or refining of natural or mineral petroleum. This type of wax has a higher molecular weight and hardness than the wax produced from hydrocarbon sources distilled from raw materials. While carnauba wax consists of a series of esters, Alcohols, as well as acids and hydrocarbons, can be controlled according to the steps included in the techniques needed in the manufacturing process. This type of wax is characterized by its high hardness, fragility, and high melting temperature. It has high quality and has a solubility and hardness similar to paraffin wax (15).

CONCLUSION

We conclude from our current research, which resulted from various experiments within sequential steps in which artificial dental wax was synthesized, that every scientific idea we can make into a written theory applicable to and benefit from and invest in it in order to develop the country's economy because the main motive of this research work is the need to Such products and the necessity of their presence in the local and international commercial markets. The main motive for the interest in the synthesis and production of artificial dental wax is that the raw materials needed for manufacturing are available in the local markets and are inexpensive, in addition to the possibility of manufacturing by biotechnological and industrial technique methods. The synthesis of artificial dental wax with high quality specifications opens the way to innovation and manufacture of other materials that may be more useful, and this motivates researchers to make more great efforts to seek more discoveries that develop the aspect of science and knowledge.

REFERENCES

1. *Craeg RG, editor. Restorative dental materials 9th ed., St. Louis: Mosby, 1992.*
2. *Lasetar RL. Control of wax distortion by manipulation. J Am Dent Assoc. 1945; 27:518–24.*
3. *Christinsen GJ. The effect of water swaging on stress and strain in Dental/wax patterns. J. Dent Res 1975;44(5):930–4.*
4. *Maves TW. Recent experiments demonstrating wax distortion on all wax patterns when heat is applied. J Am Dent Assoc. 1932; 19:606–13.*
5. *Ivanovssky L. New standards for petroleum waxes. Petroleum(London) 1944;4:108–9.*
6. *Craig RG, Eisck JD, Peyton FA. Flow of binary and tertiary mixtures of waxes. J Dent Res 1976;45(2):397–403.*

7. *Okeke K. Nkemdilim, Okorie P. Chidiebere. Production of Dental Inlay Wax Using Locally Sourced Materials in Enugu, Nigeria. 2019, See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/331555868*
8. *Stephen, C. B. (2003). Fixed Prosthodontics. Chapel Hill, NC27514.*
9. *Katakura N, Kawakami M. Rheological studies on deformation fordental waxes. 2. Stress relaxation behavior of inlay wax. Shika Rekogaku Zasshi. 1997;18(42):118–23.*
10. *Katekura N. Viscoelastic behavior of inlay waxes. J Jap Soc DentAppar. Mater 1987;21(52):209–16.*
11. *Kotseomiti E, Mc.Cabe JF. Experimental wax mixtures for dental use. J Oral Rehabil 1999;24:517–21.*
12. *Oheshi M, Pafenbarger PC. Some flow characteristics at 378C ofternary wax mixtures that may have possible dental uses. J NihonUnivSch Dent 1989;11(3):109–15 (see also p. 152).*
13. *Watenabe K. Mechanism of the anisotropic dimensional change of the wax pattern prepared by the softened wax technique. J Jap Soc. Dent Appar. Mater 1991;22(57):63–9.*
14. *Jablonski, S. (2005). Illustrated Dictionary of Dentistry, 1stedition. Philadelphia W. B Saunders Company. 868-869.*
15. *Craig, R; Erick, J. D & Peyton, F. A. (2010). Restorative Dental Material. Properties of Natural waxes used in Dentistry, 13th edition. B. C Ames Company, Waltham, Mass.1304-1313.*