



## Evaluation of Biomaterials to Support Infants in Implants in Cases of Spinal Damage Case of the Biomedical Industry of Tijuana, Mexico

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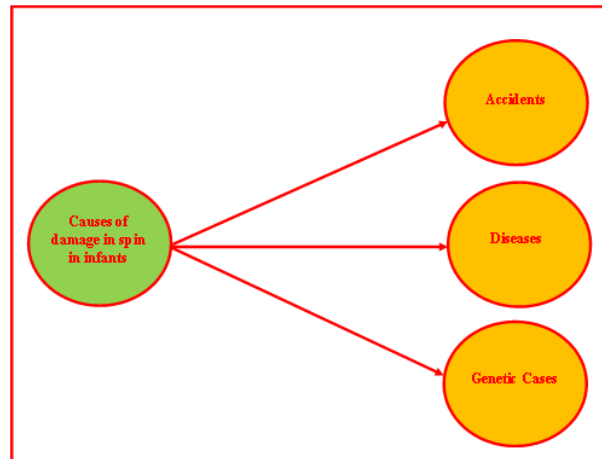
**Abstract** – The use of biomaterials is of great importance in the biomedical industry due to its great application in various types of medical treatments and implants in people, especially in infants who suffer from damage to the spine due to some risky action that they have undergone or of a genetic nature. Biomaterials, which are widely used in the biomedical industry of the city of Tijuana, are essential in medical treatments for damaged spines in infants, because they have the characteristic of generating the required shape and can be attached to the part of the body. human where you want to implant. This is why an investigation was developed to evaluate the main types of biomaterials, analyzing their physical and chemical properties and the lumbar region of the spine, to be proposed to neurosurgery specialists and orthopedists in the city of Tijuana. The objective of this investigation is to achieve a thorough and technical evaluation in order to analyze a possible action in a case with infants from 0 to 6 years, which were damaged spine by accidents, diseases or genetic cases in this city, which was developed in 2023. Also was applied strategies according to the convince personnel of the manufacturing areas to make his industrial operations with high quality and avoid any type of labor risk that can originate labor discomfort, accident or disease. This part of the investigation was made because some workers of the industrial processes were putting resistance to the new industrial activities for the use of biomaterials.

**Keywords:** Biomaterials, biomedical industry, medical implants, neurosurgery, and orthopedics.

### 1. INTRODUCTION

Cases of damage to the spine in infants from 6 to 12 years old, due to accidents, diseases or cases of genetics as is illustrated in figure 1; has increased in the last ten years worldwide, in our country, region, and the city of Tijuana is no exception in this type of health analysis in infants of this type of age (AIMT, 2023). These children are linked to various types of pediatric traumatology analysis, for rehabilitation processes with appropriate medical treatments, with the objective of evaluating the level of damage of each infant

with their respective diagnosis of critical health situations with respect to the damage of spine (Salthouse et al, 2023). Due to the large number of cases of this type of health situation in infants, and the concern about not having quick treatments and with the certainty that the spinal column of infants can be regenerated, the idea arose of carrying out a scientific study. This research was developed to evaluate biomaterials to be used as prostheses that provide life support for infants and can move on their own (Huettnner et al, 2018).

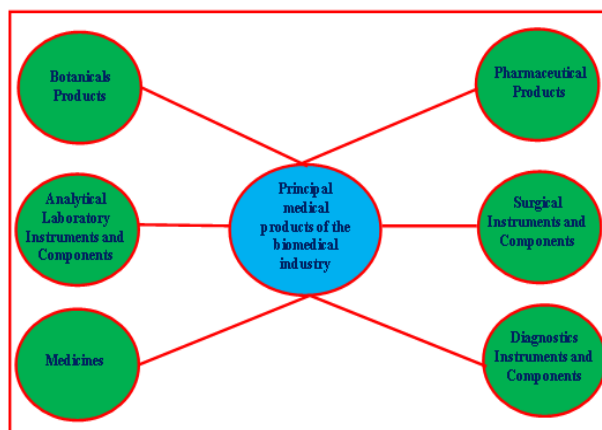


**Fig -1:** Types of factors that causes the damage of spin in infants.

Source. Analysis of investigation

## 1.1 Biomedical Industry

It is one of the most important in the world, generating millions of dollars in economic gains, and millions of jobs in a lot places (cities and remote places) in the world, being relevant to the manufacturing of specialized products utilized in a diverse and a lot medical activities in clinical, hospitals and remote places where is necessary the health attention to populations (Vishwakarma et al, 2016; Donate et al, 2020). The medical products fabricated in this type of industry are presented in figure 2 (Pupilli et al, 2022; Lock et al, 2019):



**Fig -2:** Principal medical products manufactured in the biomedical industry at the worldwide

Source. Analysis of investigation

As is observed in figure 2, the six principal medical products fabricated in the biomedical industries of the world including the Tijuana city, which are distributed some products fabricated in this important region of the Mexican Republic.

## 1.2 Biomaterials Used In the Industry

A biomaterial is a substance and compound, which is more utilized in a different function, being the principal action therapeutic activities to develop medical implants to regenerate or replace any tissular function of the body (Lendlein et al, 2012). Biomaterials were developed from 50 years ago, and was supported in a great operations and actions in the clinical activities, which the branch that study this type of material, which is called biomaterials science and engineering biomaterials. Great quantity of industrial companies of the biomedical industry, in the world are inverted a lot money in the development of biomaterials to be utilized in therapeutic activities, essentially in infants. Biomaterials have three principal characteristics, which are mentioned next table (Uludag, 2014; Dadfar et al, 2019):

**Table -1:** Characteristics of biomaterials

Characteristics	Function
Bioactivity	Represents the capacity of a biomaterial to induce a physiological answer. To support in the operative yielding of the biomaterial
Auto-assembly	Is a presentation of the biological structure of the biomaterials to generates the adequate function of the biomaterials
Hierarchy structure	Represents the forms that is structured each biomaterial, evaluating each layer of the structure and analyzing each part of the biomaterial.

Table 1 shows the essential characteristics of a biomaterial to design and develop with specialized industrial devices and equipments to be fabricated as a efficient biomaterial and have effective functions in the clinical activities.

## 1.3 Medical Implants

Are medical devices and compounds to be used and coupled with parts of human body, when is necessary to regenerate or replace functions of extremities or articulations of the body. Its principal objective is be compatible with the human body parts, where will be implanted, after some clinical studies of each person that need a medical implant (Roseti et al, 2017; Guarino et al, 2009). These devices are manufactured of specialized materials and in the last 20 years are be utilized biomaterials, which are similar to ceramic, metallic or plastics materials used in the medical implants, which are implanted with surgical actions in the part of the body where is necessary. The medical implants are classified in three class, which are controlled by specialized institutions as the Food Drugs Administration (FDA) of the United States and be regulated by the risks in persons who need medical implants, and showed in table 2 (Hofmann et al, 2009; Patel et al, 2018).

**Table -2:**Class of medical implants

Class	Aspects
I	Are considered of the less risk and can be utilized with a low clinic necessity
II	Have a medium risk and be used in some clinical necessities without generates a high risk in persons
III	Are utilized in major clinical necessities as the heart functions of the human body

## 1.4 Internal Marketing Strategies in Industrial Activities

The person who works in this thematic have the function of convince to any person that elaborate any type of activity to increase his operative yielding. This relevant thematic has being very important from around 20 years ago, to supported the organizations, public institutions and industrial companies to improve the functions and obtain effective actions from all workers. In this investigation was utilized this interesting thematic to convivence to personnel of the manufacturing areas in a biomedical industry located in the Tijuana city, because was made a resistance of the new industrial process of the workers and be improved the mental aspect of workers (women and men) to increase productivity and quality indices. The principal function of internal marketing is the communication with three essential characteristics, which are expressed in table 3.

**Table -3:**Characteristics of internal marketing communication

Characteristics	Functions
Newsletters	Are used as informative aspects to workers to be read in his free times as lunch time
Meetings	Have the function of inform and give basic or complex instructions to convince workers to make his industrial operations with effective actions
Corporate events	Are utilized to generates relevant information from directive and managers to specialized people, engineers and supervisors to replicate to operative people

## 2. METHODOLOGY

This investigation generates relevant information to have the determine the methos to fabricate biomaterials in the biomedical industry where was made this scientific study, being elaborated in three steps, which are expressed now:

- Evaluation of recycled biological materials to be developed as biomaterials to medical implants.
- Analysis of physicochemical properties to determine the type of use of the biomaterials in the medical implants of persons.
- Evaluation of the internal marketing strategies applied to increase the operative yielding of workers and productivity and quality levels.

### 3. RESULTS

The investigation was made to determine the principal characteristics of biomaterials evaluated in the biomedical industry, and the possibility of be applied in some persons of this industrialized city and be the behavior of the new biomaterial developed in this scientific study.

#### 3.1 Analysis of Recycled Biological Materials

In this investigation was made an analysis of some biological materials as banana, melon, watermelon and potato peels. Small pieces of the shells were obtained and liquefied to obtain a mixture that generates an aqueous mass with the aim of making resistant layers to develop the structures of the proposed biomaterials. To the different shells of the recycled materials mentioned above, evaluating their texture, resistance and durability characteristics, which are presented in table 4.

**Table -4:** Characteristics of diverse peels of biological recycle material (2023)

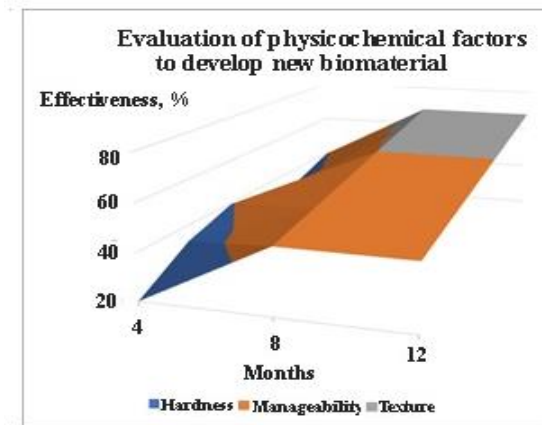
Peels	Recycle Material	Characteristics	Time of Exposure to sun rays, Hours	Possibility to be used as a biomaterial
1	Banana	Good texture and durability	10	Used to start layer
2	Cucumber	Good texture	12	Used to start layer
3	Melon	Good resistance and durability	15	Used to finish layer
4	Potatoes	Good texture and durability	11	Used to start layer
5	Watermelon	Good resistance and durability	14	Used to final layer

In table 4, is showed the principal characteristics of the peels evaluated, indicating hat can be utilized to design a new biomaterial, which can be replaced to the original materials and generates a saving of cost, and fabricate biodegradable biomaterials to reduce the climatic change in the world.

#### 3.2 Evaluation of Physicochemical Properties of a New Biomaterial

This part of the investigation was made to evaluate the physicochemical factors in around 2023 divided in four months, because was evaluated by periods of these large to determine with greater certainty about these essential characteristics and be analyzed to know the diverse forms to be utilized this type of new biomaterial or need make any type of improvement to obtain the best results in the medical implants to analyze the process with the adequate coupling with the body of each person. Is necessary mention that any type of material utilized to medical implants, can't be coupled very easy to any person and in sometimes debit be make diverse improvements and with this can make the medical therapeutic actions to recover the health of infants. This is illustrated in figure 3, where is showed by three different colors about the three main physicochemical factors evaluated. In the first zone of this figure is observed with the light blue color with the hardness property, reflecting from the first time of the period of the investigation, following of orange color where was improved from the six months, indicating the manageability and finally

the texture with the gray color to determine from the nine month the good conditions of this new biomaterial.



**Fig -3:**Analysis of physicochemical properties of the new biomaterial (2023)

### 3.3 Correlation Analysis of Internal Marketing Strategies and Industrial Factors

Was made a correlation analysis illustrating in table 5, where is observed that with the application of the specialized strategies of internal marketing were increased the operative yielding of workers and with this the productivity and quality indices.

**Table -5:** Correlation analysis of the application of specialized strategies of internal marketing and the operative yielding in the biomedical industry (2023)

Workers	Sex	OYBAIM, %			OYAAIM, %		
		N	M	CE	N	M	CE
1	Men	67	70	66	80	89	90
2	Men	70	68	69	84	92	88
3	Women	69	73	68	88	90	87
4	Women	72	75	70	85	94	89
5	Women	65	73	73	84	94	90
6	Men	69	69	72	87	92	92
7	Men	73	71	70	80	90	91
8	Men	70	70	71	82	91	88
9	Women	72	73	70	88	89	86
10	Women	70	70	73	85	90	89
Total							

Newsletters-N, Meeting-M, Corporate Events-CE (conferences and work meetings)

Operative Yielding Before Apply the Internal Marketing-OYBAIM

Operative Yielding After Apply the Internal Marketing-OYAAIM



The major aspect were the meetings to convince workers of the manufacturing areas, and be effective before begin each shift of the biomedical industry evaluated. This mean that was relevant this section of this scientific study.

## 4. CONCLUSIONS

This investigation was relevant in the design and development of new biomaterials, utilizing as a reference recycle biological materials, to fabricate a new biomaterial that can replace the original metallic materials, and improve the operative yielding of personnel and industrial equipment and machinery utilized in the manufacturing areas. The analysis of the physicochemical properties is very important to determine the characteristics of the new biomaterial evaluated and determine in each medical implant its effectiveness. The use of the specialized strategies of internal marketing were important because supported to increase the operative yielding of the operative personnel of manufacturing areas and wit this the productivity and quality levels. This means that this new biomaterial can generate good conditions to be use in medical implants.

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