THE EFFECT OF ADDING SOME CHEMICAL MATERIALS ON THE WATER POWDER RATIO OF DENTAL STONE

RUNNING TITLE: THE EFFECT OF CHEMICAL MATERIALS ON THE DENTAL STONE

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Abstract: **The aims:** To determine the effect of some chemical materials on the water powder ratio of dental stone. **Material and Methods:** Three types of chemical materials (rosin, nigella stavia oil and sodium lauryl sulfate) were incorporated into three kinds of type III dental stone (Zeta, Elite and Dental stone) at four concentrations (0.5%, 1%, 1.5% and 2%). The collected data of water powder ratio were subjected to the descriptive analysis (mean and stander deviation), student T test (to evaluate the difference between standard and experimental groups) and one-way analysis of variance (ANOVA) (to show if there are significant differences among experimental groups). **Results**: Revealed that the incorporation of these chemical materials into each type of dental stone resulted in changing their evaluated water powder ratio; this change varies with the type, concentration of the added chemical material and type of dental stone being used. **Conclusion:** The most pronounced effect of the chemical additives that used in this study on the water powder ratio of the experimental dental stones was achieved with the addition of sodium lauryl sulfate.

Keywords- water powder ratio, dental stone, plaster, Elite, Zeta

1. INTRODUCTION

Although gypsum products have been successfully used for many years, numerous attempts have been managed to develop die material with improved properties. Recent studies have concentrated on the addition of chemical materials into the dental stone in order to improve its properties [1,2].

Water requirement is the most important property of calcined gypsum [3], it is an important factor in the quality of gypsum material and in order to compare mechanical properties of gypsum products, specimens must be prepared with uniform consistency [4].

The effect of additives varies according to the nature of additive being added to gypsum products. Ridge and Boell[5] showed that the addition of gelatin, egg, albumin, sodiumhexamethaphosphate, sodium borate, sodium alginate and tannic acid to gypsum products increase the water requirement. Whereas, the addition of sodium citrate, ethelenediamine tetra-acetate and saponin reduce the water- powder ratio.

Combe and Smith [6] showed that the incorporation of wetting agents such as lignosulfate could reduce the water requirement of stone. Another study done by Zakaria *et al* [7] on the effect of liquid dispersing agent and microcrystallin additives on the physical properties of type IV gypsum showed that these additives affect the consistency

of the mix, but the consistency can be kept close to that of the stander by lowering the water-powder ratio.

Anusavice [8] stated that when a small amount of surface active materials such as gum arabic plus lime added to hemihydratre can reduce markedly the water requirement of both plaster and dental stone.

Al-Sadi*etal* [9] found that the addition of 1% Arabic gum and 0.132% calcium hydroxide to type III and IV dental stone helped in reducing the mixing water-powder ratio. This was in agreement with the conclusions done by Abdelaziz *et al* [10].

Taha *et al* [11] concluded that the addition of 0.2% chlorhexidine to dental stone did not show any change in water-powder ratio. Whereas Twomey *et al* [12] found that when calcium hypochlorite was added to dental stone, extra mixing water was required to produce a material of the same consistency.

This study aimed to evaluate the effect of adding some chemical materials (rosin, nigella stavia oil and sodium lauryl sulfate) on the water powder ratio of dental stone as follows: Testing the change in the water powder ratio of the dental stone before and after the addition of chemical materials. Comparing the resultant physical and mechanical properties of dental stone (after the addition of chemical materials) with the properties of plaster (negative control) and the properties of die stone (positive control).

2. MATERIALS AND METHODS

The materials used in this study are tabulated in)Table 1 ***Table (1): Materials Used in this Study.***

	product	manufacture	BACH NUMBER
	Plaster	Al-Ahliya co. for gypsum industries Lid	--------
	Silky rock (Type IV)	Whip-mix Grop. Louisville,U,S,A.	70398
	Elite (Type III)	ZHERMACK SPA-45021 BADIA POESINE, ITALY	Iso 6873
	Zeta (type III)	**Seienor,industria zingardi s.r.l.Ligure Italy**	*GSGIA0702*
	Dental stone (Type III)	China Meheco co. P.R. China	20000801
Chemical	***Sodium Lauryl Sulfate***	NDI	---------
	Rosin	Natural product	--------
	Nigella Stavia Oil	Natural product	--------

Three types of dental stone (Zeta, Elite and Dental stone) were used in this study into which three types of chemical materials were added (rosin, nigella stavia oil and sodium lauryl sulfate). The chemical materials were added to the powder of dental stone in four percentages (0.5%, 1%, 1.5%, and 2%).

The effect of these chemical materials on the water powder ratio of the experimental dental stones (Zeta, Elite and Dental stone) had been evaluated by measuring the water-powder ratio before and after the addition of chemical materials.

Mixing procedure employed in the preparation of all the test specimens followed the ADA specification No. 25 for gypsum products [13] .

The water-powder ratio was measured by using modified vicat apparatus according to ADA specification No.25. The collected data of water powder ratio were subjected to the descriptive analysis (mean and stander deviation), student T test (to evaluate the difference between standard and experimental groups) and one-way analysis of variance (ANOVA) (to show if there are significant differences among experimental groups).

3. RESULT

The mean and stander deviation of the measured water- powder ratio of the three types of dental stone after being blended with the chemical materials is listed in (Table 2).

This table revealed there is an alteration in the water- powder ratio of these dental stones being blended with the chemical materials. However, Statistical analysis reveals that there is no statistical significant difference in the water- powder ratio between experimental and control groups of the three types of dental stone after the addition of rosin except that a significant reduction in the water-powder ratio of Dental stone when it is blended with rosin at concentration of 1 and 1.5%at ($t=8.062$, $t=8.66$, $p<0.05$). A significant reduction was seen in the water-powder ratio of Zeta stone at ($t=4.373$, $t=7.071$, 8.345, $p<0.05$) after the addition of rosin at a concentration of 0.5, 1and 1.5%.

The addition of nigella stavia oil to each of the three types of dental stones reduces their water-powder ratio. However, this reduction was not statistically significant, except that when nigella stavia oil has been added at a concentration of 1% to Dental stone ($t=4.243$ $p<0.05$) and at a concentration of 0.5 and 1 % when it added to Zeta at ($t=4.333$, $t=5.960$, $p<0.05$)

The most pronounced effect of the chemical additives on the water-powder ratio of the experimental dental stones was

achieved with the addition of sodium lauryl sulfate. A statistically significant reduction in the water-powder ratio of both Zeta and Dental stone has been achieved with the addition of sodium lauryl sulfate and this reduction was directly proportional to the concentration of the sodium lauryl sulfate being added at $p<0.05$. While a statistically significant reduction in the water-powder ratio of Elite stone has been achieved after the addition of sodium lauryl sulfate at a concentration of 2 % at ($t=5$, $p<0.05$).

One-way analysis of variance (ANOVA) revealed that there is a statistically significant difference in the water- powder ratio between the control and the experimental groups after being blended with the chemical materials (rosin, nigella stavia oil, sodium lauryl sulfate) at ($f=6.62$, 4.8 and $p<0.05$) for Zeta, and Dental stone respectively.

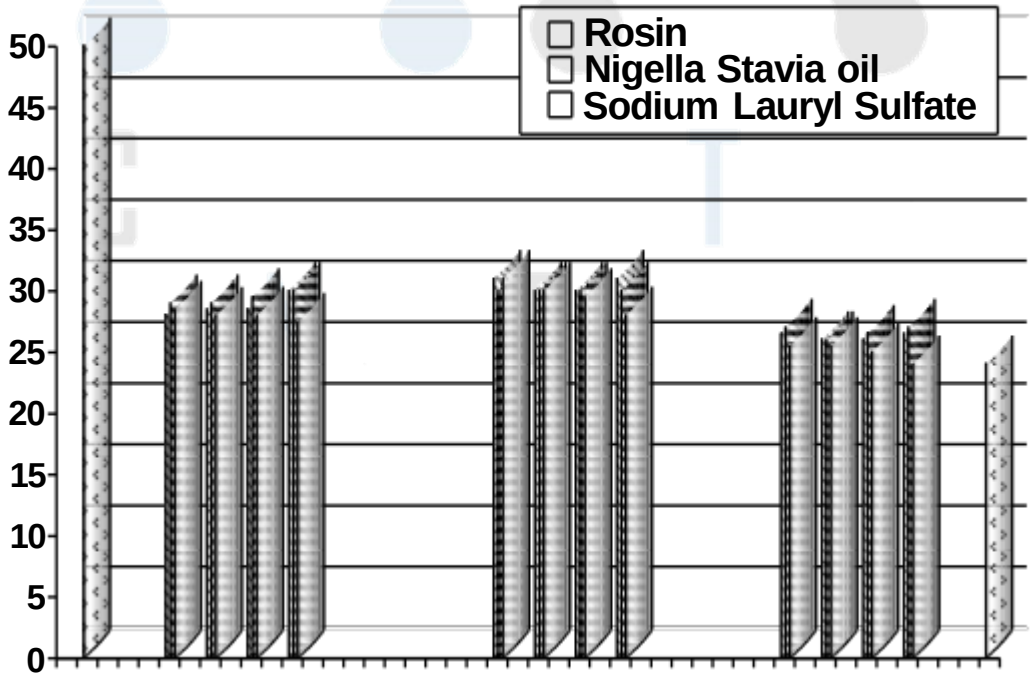
However, this difference is not statistically significant when those chemical materials was added to Elite stone at ($f = 1.37$, $p < 0.05$) except that when sodium lauryl sulfate was added to Elite at 2% concentration.

By comparing the effect of chemical additives on the water-powder ratio of the experimental dental stones with the water-powder ratio of -ve control(plaster) and that of +ve control(die stone), we can note that the water-powder ratio of experimental dental stones (Figure 1) remain between the water-powder ratio of -ve and +ve except that when sodium lauryl sulfate has been added to Dental stone at 2% concentration, in which the water-powder ratio reaches the water-powder ratio of +ve control

Table (2): The Effect of chemical additive on the water powder ratio of dental stone

%	Zeta +R	Elite+R	Dental stone+ R	Zeta+ NS	Elite+NSO	Dental stone+ NSO	Zeta+SLS	Eite+SLS	Dental stone+ SLS
0.5%	28*(0.8)	31(1.4)	26.5(0.4)	29*(0.7)	30(0.5)	27(0.8)	30(0.4)	31(0.8)	26*(0.7)
1%	28.5*(0.4)	30(0.8)	26*(0.4)	29*(0.8)	30(0.8)	26*(0.8)	29.5(0.4)	30.5(1.01)	25.5(0.8)
1.5%	28.5*(1.2)	30	26(0.5)*	29*(0.4)	30(0.8)	26.5(0.4)	29*(0.4)	29.5(0.5)	24.5(0.5)
2%	30(0.8)	31(0.4)	26.5(0.4)	30(0.7)	31(0.3)	27(0.8)	28*(0.4)	28.5*(0.8)	24(0.4)
control	31(0.8)	30(1.6)	27.5(0.4)	31(0.8)	32(1.6)	27.5(0.4)	31(0.8)	32(1.2)	24.5(0.4)

R: Rosin, NSO: Nigella Sativa Oil, SLS: Sodium Lauryl Sulfate,
***Statistically Significant from control sample at $p < 0.05$**
() standared deviation



4. DISCUSSION

The water-powder ratio must be carefully controlled because of the deviation from this ratio which is recommended by the manufacturer will change both

consistency of the material and the properties of the set mass [13,14]. Many experimental attempts to improve the mechanical properties of dental stone are oriented mainly towards the decrease of the gauging water requirement [16].

In this study, the examined water-powder ratio varies with respect to the type of stone being used and the type and concentration of the chemical materials being incorporated with it.

According to the results of this study, the addition of the chemical materials causes a reduction of the water-powder ratio of the experimental dental stones. It appear that the surface condition of grains of hemihydrate play an important role in determining the water requirement [3]. The addition of the chemical modifier would change the adhesive force in the compacted powder, allowing the powder particles to be more easily wetted by water and thereby reduces the water requirement [17,18]. This was advocated by Craig and Powers [19] who reported that the difference in the physical shape and nature of the crystals makes it possible to obtain the same consistency with less excess water. This means that the variations that may occur in the surface properties of hemihydrate crystals in response to the addition of chemical materials play an important role in changing the water- powder ratio.

5. CONCLUSION

The differences in the examined properties of dental stone, which is basically calcium sulfate hemihydrate, related to the different interactions between the chemical additives and the hemihydrate. Incorporating of suitable chemical materials can produce dental stone with superior mechanical properties.

6. REFERENCES

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