

A Comparison of the Efficacy and Drying Times of Liquid, Gel and Foam Formats of Alcohol Based Hand Rub

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INTRODUCTION

Alcohol based hand rubs such as iso-propanol (IPA) or ethanol (EtOH) are widely used for hygienic hand disinfection and are presented in different formats i.e. liquid, gel or foam. This study was designed to determine if there is any difference in efficacy between these 2 active ingredients in the 3 formats. In addition, an assessment of the drying time was carried out.

METHODS

Formulations assessed

- 60% v/v IPA in liquid, gel and foam format
- 80% v/v ethanol plus 1.45% v/v glycerol (WHO formulation) in liquid, gel and foam format

Efficacy: For each active ingredient, an EN1500 test was carried out with 20 volunteers. The reference product was 2 x 3ml of 60% isopropyl alcohol (IPA) for 60 seconds, as described in EN1500. All three formats for each active ingredient were assessed using 3ml for 30 seconds. Each volunteer tested all three formats, their order of application decided by a Latin square design.

Drying time: Two different volumes (1.5 and 3.0ml) of the test formulations in liquid, gel or foam format were applied to the hands of 15 volunteers. They self-reported when the hands were dry and the time was recorded. The time taken was rated on a 3 point scale; too short, OK and too long by each volunteer. Linear regression models were fitted to the log-transformed drying times, whilst proportional odds logistic regression models were fitted to the volunteer ratings.

Table 1 EN1500: 60% IPA.

	6ml 60% IPA, 60 seconds Reference)	3ml 60% IPA liquid, 30 seconds	3ml 60% IPA Gel, 30 seconds	3ml 60% IPA Foam, 30 seconds
Mean log RF	5.39	4.19	4.26	4.22
Std Dev	1.09	0.99	0.81	1.22

Table 2 EN1500: 80% EtOH.

Subject No	6ml 60% IPA, 60 seconds Reference)	3ml 80% EtOH liquid, 30 seconds	3ml 80% EtOH Gel, 30 seconds	3ml 80% EtOH Foam, 30 seconds
Mean log RF	5.05	4.03	4.52	4.34
Std Dev	0.86	0.91	1.13	1.00

Table 3 Mean drying times 80% EtOH (seconds).

Format	Volume		Marginal means (Format)
	1.5ml	3.0ml	
Gel	27.47	43.87	35.67
Foam	19.67	35.67	27.67
Liquid	24.20	35.07	29.64
Marginal means (Volume)	23.78	38.20	-

Table 4 Mean drying times 60% IPA (seconds).

Format	Volume		Marginal means (Format)
	1.5ml	3.0ml	
Gel	31.53	63.13	47.33
Foam	26.33	46.00	36.17
Liquid	27.07	46.13	36.60
Marginal means (Volume)	28.31	51.75	-

Figure 1

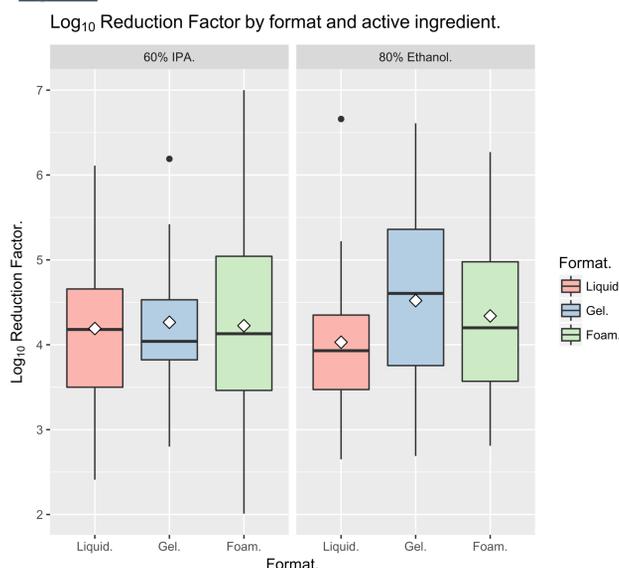


Figure 2

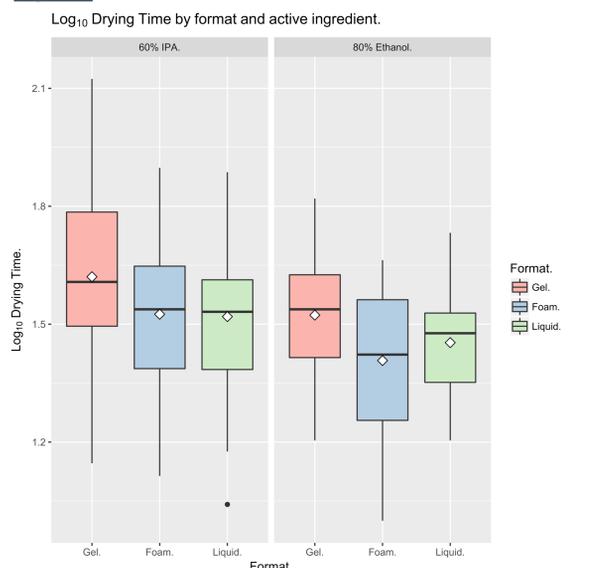
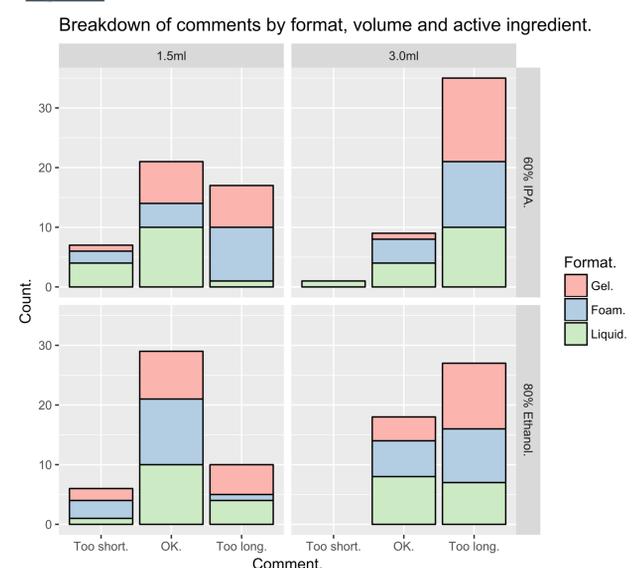


Figure 3



CONCLUSION

This study demonstrates that there is no difference in efficacy attributable to format for liquid, gel or foam for two “standard” ABHR formulations. (60% IPA or 80% EtOH) when tested in the same manner using the methodology described in EN 1500. When measured objectively, EtOH formulations tend to dry faster than IPA. For both formulations, gels take longer to dry than other formats. User perception broadly agrees with measurement; IPA is perceived to take longer to dry than EtOH. For both formulations, 1.5ml is more likely to be considered “about right” while 3ml is “too long”. For IPA formulations, liquids are perceived to dry faster than the other formats. Little format effect on drying perception is observed for the EtOH formulation. However at 1.5ml there is a greater tendency for foams to be perceived as “about right” compared to the other formats.

RESULTS

Efficacy

For the EN1500 involving IPA, the log₁₀ RF's obtained by the reference was 5.39 whilst for the liquid, gel and foam they were 4.19, 4.26 and 4.22, respectively (Table 1; Figure 1). All of the products failed to meet the criteria of EN1500 (2013), with margins of inferiority greater than 0.6 log₁₀ units. However, the difference in mean log₁₀ RF between the formats was not significant ($p=0.961$, ANOVA). For the EN1500 involving ethanol, the log₁₀ RF's obtained by the reference was 5.05 whilst for the liquid, gel and foam they were 4.03, 4.52 and 4.34, respectively (Table 2; Figure 1). Again, all of the products failed to meet the criteria of EN1500 (2013). The difference in mean log₁₀ RF between the formats was, again, not significant ($p=0.139$, ANOVA). Overall, there was no evidence of a difference in the efficacy of the two active ingredients ($p=0.7054$, two-sample t-test).

Drying time

For 60% IPA, drying time increased with volume ($p=3.39 \times 10^{-12}$) for all formats. Foams and liquids are associated with shorter drying times than gels ($p=0.0174$ and 0.0116 , respectively). There was no difference in drying times between foam and liquid formats ($p=0.9869$, Tukey contrast), (Table 3; Figure 2). Volunteers perceived liquid to dry more quickly than gel or foam ($p=0.0041$), (Figure 3). For 80% ethanol, the drying time increased with volume ($p=3.46 \times 10^{-13}$) for all format and both foams and liquids are associated with shorter drying times than gels ($p=0.000263$ and 0.023352 , respectively). There was no difference in drying times between the foam and liquid formats ($p=0.296648$, Tukey contrast), (Table 4; Figure 2). There was little difference in volunteer perception of drying times between the different formats ($p>0.05$). When comparing the two active ingredients across all formats, the drying time for 80% ethanol was significantly shorter than for 60% IPA (mean 28.92 seconds versus 35.89 seconds; $p=0.0008516$, Welch two-sample t-test). Volunteers tended to perceive 60% IPA as being more likely to take too long to dry, but this fell just short of significance ($p=0.0502$), (Figure 3).

CONFLICT OF INTEREST

All materials for this study were funded by Deb Group Ltd. JH and KO are employed by Deb Group Ltd