

STUDY OF THE RELATIONSHIP BETWEEN THE INITIAL RATE OF MOISTURE
SORPTION/DESORPTION OF NORFLOXACIN TABLETS TO THE TOTAL MOISTURE
AND TEMPERATURE OF SURROUNDING ENVIRONMENT

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ABSTRACT

The relationship between absolute moisture content of air (expressed as pounds of water per pound of dry air) at 25°C and 40°C to the initial rate of moisture sorption/desorption of NORFLOXACIN tablets was studied. At the temperatures and relative humidities in the study, linear relationships were observed.

The initial rate of moisture sorption/desorption was found to be dependent upon both the moisture content as well as the temperature of the surrounding environment.

INTRODUCTION AND OBJECTIVES

Various investigators have studied the relationship between the humidity of the atmosphere and the moisture contents of pharmaceuticals. (1-5) The relationship between the initial water content and changes in moisture content during storage to physiochemical properties such as breaking strength, disintegration time and dissolution rates have also been evaluated. (6-11)

NORFLOXACIN tablets prepared by conventional granulation procedures exhibit unpredictable dissolution characteristics which were found related to residual granulation moisture and the presence of certain desirable hydrate(s) of the drug. These attributes, it was found, could be induced into the granulation and tablets by treatment at certain relative humidities and temperatures. (12)

The objective of this study was to determine whether the initial rate of moisture sorption/desorption noted during exposure to certain humidities and temperatures was related to the total moisture at the environment alone or to the temperature as well.

EXPERIMENTAL

Tablets were monolayered in open petri dishes and exposed to: 40°C/20% Relative Humidity (RH), 40°C/32% RH, 40°C/49% RH, 40°C/79% RH, 25°C/23% RH, 25°C/33% RH, 25°C/53% RH and 25°C/93% RH. Saturated salt solutions were used to obtain the humidities. (13)

The tablets were weighed at predetermined intervals over 8 hours and their moisture contents were measured as weight gained or lost by the same set of ten tablets. Subsequently converted to grams of water/100 grams of tablets when plotted against time rates could be determined as gms of water absorbed or desorbed per 100 gms of tablets per hour.

RESULTS AND DISCUSSION

Table 1 lists the absolute moisture content of air (expressed as pounds of water per pound of dry air at 25°C and 40°C.) Figures 1 and 2 show the amount of water absorbed or desorbed per 100 gms

TABLE 1

Amount of Absolute Moisture Content of Air at Various
Relative Humidities at 25°C and 40°C

	<u>Pounds of Water/ Pound of Dry Air⁽¹⁾</u>
25°C/93% RH	0.0177
25°C/53% RH	0.0085
25°C/33% RH	0.005
25°C/23% RH	0.003
40°C/79% RH	0.036
40°C/49% RH	0.023
40°C/32% RH	0.015
40°C/20% RH	0.009

(1) Values obtained from psychrometric charts from Chemical Engineering Handbook

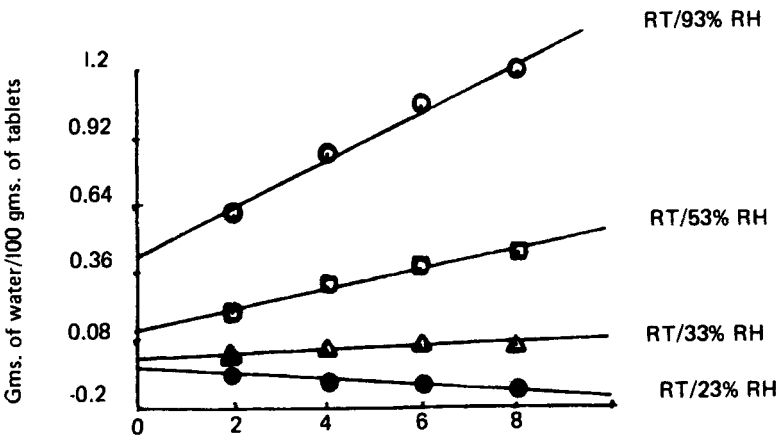


Figure 1: Amount of water absorbed/desorbed per 100 gms of tablets at different relative humidities at 25°C.

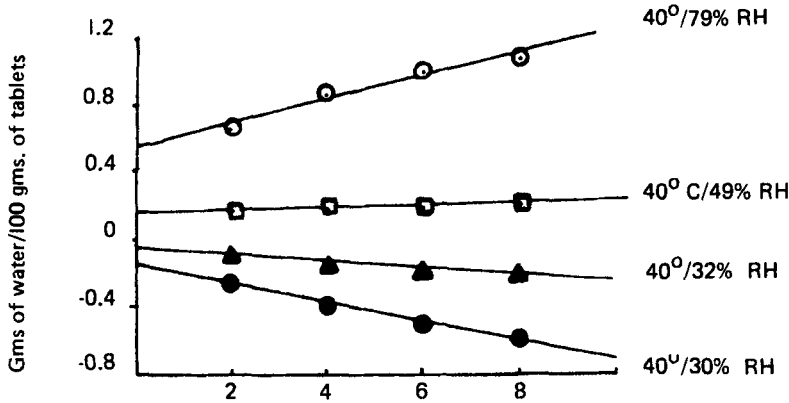


Figure 2: Amount of water absorbed/desorbed per 100 gms of tablets at different relative humidities at 40°C.

of tablets at specified temperature/relative humidity conditions over 8 hours. Moisture sorption occurs at 25°C/93% RH, 25°C/53% RH and 25°C/33% RH; while desorption occurs at 25°C/23% RH. At 40°C tablets absorb moisture at 79% RH and 49% RH, but lose moisture at 32% RH and 20%RH.

Table 2 is a compilation of the coefficients and mathematical parameters derived by plotting the temperature/relative humidity conditions in Figures 1 and 2. The R^2 values indicate a good data fit.

Figures 3 and 4 show the relationships between the initial rates of moisture sorption/desorption and percent relative humidity at 25°C and 40°C respectively. The relationship between the initial rates of moisture absorption/desorption to the absolute moisture content are shown to be linear with positive slopes and acceptable R^2 values.

TABLE 2

Equation Correlation Coefficients and Parameters for Moisture Sorption/Desorption at Various Humidities at 25°C and 40°C

Condition	R ²	Intercept(a)	Slope(b)	Observation
25°C/23% RH	0.912	0.040	0.011	Desorption
25°C/33% RH	0.840	0.024	0.005	Sorption
25°C/53% RH	0.979	0.155	0.035	Sorption
25°C/93% RH	0.983	0.417	0.099	Sorption
40°C/20% RH	0.988	0.182	0.055	Desorption
40°C/32% RH	0.924	0.073	0.017	Desorption
40°C/49% RH	0.887	0.161	0.007	Sorption
40°C/79% RH	0.960	0.545	0.071	Sorption

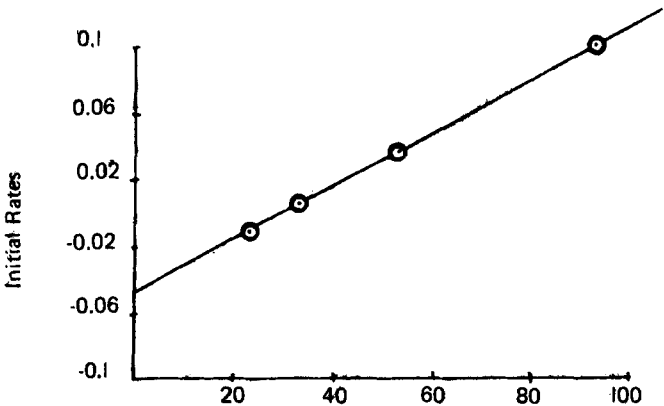


Figure 3: Relationship of relative humidity at 25 C°to the initial rate of moisture sorption/desorption by tablets stressed at indicated relative humidity.

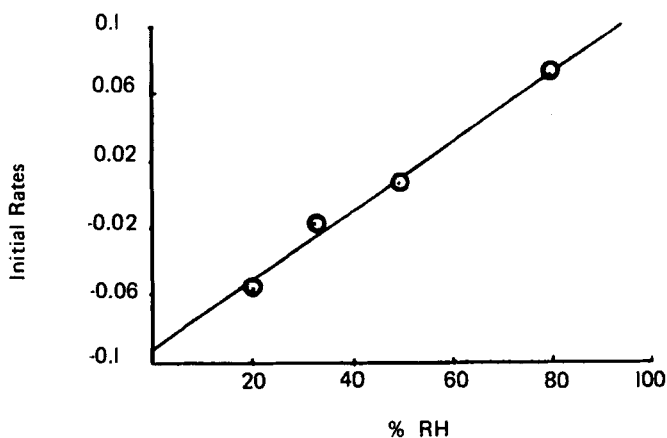


Figure 4: Relationship of relative humidity at 40 C° to the in initial rate of moisture sorption/desorption by tablets stressed at indicated relative humidity.

TABLE 3

Comparison Between the Actual Rates of Sorption/Desorption with the Predicted Values

	<u>Actual Rates</u>	<u>Predicted Rates</u>
25°C/23% RH	-0.011	-0.08
25°C/33% RH	0.005	-0.07
25°C/53% RH	0.035	-0.06
25°C/93% RH	0.099	-0.01
40°C/20% RH	-0.055	0.04
40°C/32% RH	-0.017	0.08
40°C/49% RH	0.007	0.14
40°C/79% RH	0.071	0.24

If the rates of moisture sorption/desorption are independent of temperature but a function of total moisture content, it should be possible to predict the rates of moisture sorption/desorption at any temperature by application of an equation, describing a relationship between the rates and percent RH, derived, for example at, 25°C. Predicted rates, different from the actual rates, would then suggest a dependency on temperature as well. Such was the case in this study.

Table 3 shows a comparison between the actual rates of sorption/desorption and predicted rates. It can be seen that the rates of moisture sorption/desorption are different and therefore not a function of total moisture content but dependent upon temperature as well.

CONCLUSION

Although linear relationships were found to exist between the relative humidity and the rates of moisture sorption/desorption at 25°C as well as 40°C, the initial rates of moisture absorption and desorption of NORFLOXACIN tablets were found to be dependent on temperature as well as relative humidity of their surrounding environments. The rate equations are not a function of total moisture content alone but has a complex functional dependency on temperature as well.

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