**Report**

February 2023

# Comparative study pH-Fix test strips

## 1. Summary / Abstract

In the following study, the pH-Fix 0-14 test strips from MACHEREY-NAGEL (REF 92110) and the MQuant®* pH 0-14 test strips from Merck* (REF 1.09535.0001) were tested and compared for their accuracy in determining pH values. The tests subjects (with and without laboratory experience) performed comparative tests with buffer solutions. After evaluating the results, the test subjects were able to correctly reproduce the pH value of the test solutions with the product pH-Fix 0-14 test strips (MN) with a rate of 88 %. For the MQuant®* pH 0-14 test strips (Merck*), this rate was 80 %.

## 2. Study design

In this usability study, two non-bleeding pH test strips of the above products were compared. The study details can be found in the following chapters.

### 2.1. Question

The aim of the study was to determine the accuracy of the two test strips pH-Fix 0-14 (MN) and MQuant®* pH 0-14 (Merck*) for the exact and correct determination of pH values when used by test subjects.

### 2.2. Products

The following products were compared:

| Product | pH fix 0-14 | MQuant®* pH 0-14 |
|---|---|---|
| Company | MACHEREY-NAGEL | Merck* |
| Item number | REF 92110 | REF 1.09535.0001 |
| LOT | 10D0121 | HC151257 |


## 2.3. Subjects

15 (w = 8, m = 7) of our employees aged between 20 and 50 were selected as test subjects. Four of the 15 participants already had laboratory experience in determining the pH value of buffer solutions with pH test strips. 11 of the 15 persons were laymen without laboratory experience.

| Subjects | Quantity |
|---|---|
| N (number of subjects) | 15 |
| Gender (f/m) | 8/7 |
| Without/with laboratory experience | 11/4 |

## 2.4. Comparison of the pH value determination

In the first sub-study, the subjects had to determine the pH of 15 unknown buffer solutions using the two comparison products. Titrisol® buffers from Merck* were used for the standard solutions (with the exception of 0.1,13 and 14). The stock solutions with a pH of 0.1,13 and 14 were prepared using 1 M hydrochloric acid, 0.1 M hydrochloric acid, 0.1 M sodium hydroxide solution and 1 M sodium hydroxide solution. All pH values between 0-14 were prepared in increments of 1 and measured blindly in different sequences. The subjects had to note down the pH value after each determination of a buffer solution.

# 3. Results

## 3.1. Comparison of pH value determination - pH-Fix 0-14 (MN)

Table 1 shows the results of the pH value determinations of the pH-Fix 0-14 test strips from MACHEREY-NAGEL. In this cross diagram, the correctly read pH values are marked in green. Deviations of +/- 1 pH value are marked in yellow. Deviations of more than one pH value are highlighted in red:

| Total | | Target pH value | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Measured pH value | 0 | 9 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 1 | 6 | 5 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 2 | - | - | 14 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3 | - | - | - | 15 | - | - | - | - | - | - | - | - | - | - | - |
| | 4 | - | - | - | - | 15 | - | - | - | - | - | - | - | - | - | - |
| | 5 | - | - | - | - | - | 15 | - | - | - | - | - | - | - | - | - |
| | 6 | - | - | - | - | - | - | 15 | - | - | - | - | - | - | - | - |
| | 7 | - | - | - | - | - | - | - | 15 | - | - | - | - | - | - | - |
| | 8 | - | - | - | - | - | - | - | - | 15 | - | - | - | - | - | - |
| | 9 | - | - | - | - | - | - | - | - | - | 15 | - | - | - | - | - |
| | 10 | - | - | - | - | - | - | - | - | - | - | 15 | - | 1 | - | - |
| | 11 | - | - | - | - | - | - | - | - | - | - | - | 14 | 2 | - | - |
| | 12 | - | - | - | - | - | - | - | - | - | - | - | 1 | 12 | 1 | - |
| | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | 9 | - |
| | 14 | - | - | - | - | - | - | - | - | - | - | - | - | - | 5 | 11 |

Table 1: Comparison of the nominal and actual pH values determinations with the test strips pH-Fix 0-14 from MACHEREY-NAGEL.

## 3.2. Comparison of pH value determination - MQuant®* pH 0-14 (Merck*)

In Table 2, the results of the pH value determinations of the MQuant®* pH 0-14 test strips from Merck* are plotted. In this cross diagram, the correctly read pH values are marked in green. Deviations of +/- 1 pH value are marked in yellow. Deviations of more than one pH value are highlighted in red:

| Total | | Target pH value | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Measured pH value | 0 | 12 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 1 | 3 | 12 | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 2 | - | 2 | 12 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3 | - | - | - | 15 | - | 1 | - | - | - | - | - | - | - | - | - |
| | 4 | - | - | - | - | 14 | - | - | - | - | - | - | - | - | - | - |
| | 5 | - | - | - | - | - | 12 | - | - | - | - | - | - | - | - | - |
| | 6 | - | - | - | - | - | 2 | 14 | 5 | - | - | - | - | 1 | - | - |
| | 7 | - | - | - | - | - | - | 1 | 10 | 9 | - | - | 1 | - | - | - |
| | 8 | - | - | - | - | 1 | - | - | - | 7 | - | - | - | - | - | - |
| | 9 | - | - | - | - | - | - | - | - | - | 10 | 1 | - | - | - | - |
| | 10 | - | - | - | - | - | - | - | - | - | 5 | 12 | 1 | - | - | - |
| | 11 | - | - | - | - | - | - | - | - | - | - | 2 | 11 | - | - | - |
| | 12 | - | - | - | - | - | - | - | - | - | - | - | 2 | 14 | - | - |
| | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | 14 | 6 |
| | 14 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 9 |

Table 2: Comparison of the nominal and actual pH values determinations with Merck*'s MQuant®* pH 0-14 test strips.

## 3.3. Comparison of pH value determination - pH-Fix 0-14 (MN) vs. MQuant®* pH 0-14 (Merck*)

The correctly determined pH values of the two different pH test strips described above were set in the ratio of all comparative measurements performed and expressed in % (Table 3):

| Product | pH-Fix 0-14 (MN) | MQuant®* pH 0-14 (Merck*) |
|---|---|---|
| Total number of measurements (m) | 225 | 225 |
| Correctly determined values ($m_k$) | 198 | 180 |
| **Correctness ($m_k$ /m x 100)** | **88 %** | **80 %** |

Table 3: Comparison of the correct pH value determinations with the test strips pH-Fix 0-14 (MN) and MQuant®* pH 0-14 (Merck*).

# 4. Result

This comparative study shows that subjects were able to determine the correct pH value more frequently with the pH test strips pH-Fix 0-14 from MACHEREY-NAGEL than with the product MQuant®* pH 0-14 from Merck* (see section 3.3 above).

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