ElectroPhotonic Analysis (EPA) of tap water droplets versus hydro-alcoholic solutions

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Supplementary material

3.2 Global analysis

This strategy considers the EPA image as a whole from which a set of global indexes may be computed. These indexes are computed using the statistical tools developed since 1948 within the frame of Shannon's information theory. Such sets of global indexes allow fruitful comparisons between various images recorded either on the same sample (reproducibility) or on different samples (discrimination). Technically speaking, each image is recorded as a 512×512 square table holding N = 262 144 pixels. Each pixel is affected with an intensity (gray-level) ranging from 0 to $2^{16} - 1 = 65\,535$ values (16-bits images). A pertinent set of global indexes may then be derived by assimilating the picture to an ecosystem that could be characterized in terms of its biodiversity [38] or to an economy characterized by its spatial structure [39]. The great advantage here is that there is no uncertainty about the total number of possible intensities (R = 65 535). This is obviously not the case in ecology and economy where the total number of species or the total number of activity sector is *a priori* unknown.

The main idea is then to compute several kinds of generalized entropies from the distribution of the various gray levels represented in an image represented by its histogram. Accordingly, from ecology we know that there is more surprise in a biological community characterized by high entropy. Similarly, in economy, a highly specialized region is characterized by low entropy. By analogy, the entropy of an EPA image should be a good measure of its diversity or of its regularity. However, it may happen that two very different images are characterized by the same entropy value. A better discrimination is then obtained by considering other ways of measuring diversity or evenness. Fortunately, ecologists and economists have defined generalized entropies, symbolized as ${}^qH$, where each order q gives information on a particular feature of the ecosystem or of the economy. The drawback of the qH entropies is that they have a clear meaning only for q = 0 or q = 1. This is the reason why each index or order q is transformed into an effective number of species (ecology) or into an effective number of intensities (EPA image). Such a procedure gives rise to photo-diversity indexes, symbolized as ${}^qD$. These indexes may be easily computed from the histogram of the image by affecting to each intensity a probability $p_i = n_i/N$. Here n_i is the frequency of occurrence of intensity i ($0 \le i \le R$) in the image and N the total number of pixels:

$$qD = \left[\sum_{i=1}^{R} (p_i)^q\right]^{\frac{1}{1-q}} \quad et \quad qH = \ln qD$$

Each photo-diversity of order q (qD) being an effective number of intensity, this allows affecting a diversity profile to a given EPA image. An image having a higher diversity profile than another image may then be considered as holding more diversity. Similarly, two images are said to be "separable" if their respective diversity profile do not overlap. In case of overlaps, no order relationship could be established.

In the above formula, the order q may be any positive or negative number, integer or not. However, only positive and integer values of order q are usually considered during a diversity analysis. Negative integer values are not really interesting because they put heavy statistical weight on the rarest intensities that are the most affected by various sources of noise. Similarly, as diversity drops very quickly as q increase, the analysis is usually limited to small values (q = 0, ½, 1 and 2) and to the limit $q \rightarrow +\infty$. Here is the physical interpretation that may be given to each diversity index:

1. The diversity of null order (^0D) corresponds to the total number of gray-levels represented in the analyzed image. It characterizes the "richness" of the picture and may take any value between °D = 1 (uniform image) and $^0D = R = 2^{16} = 65536$ (perfectly random image). Here, all intensities are considered as important even those represented by a singleton. For this reason, ^0D is considered as a collector index, well adapted to a patrimonial approach of the diversity, where each new intensity is interesting by itself, because it could be due to the sample and not the noise of the camera. Each apparition of a new intensity in an image has always the consequence of increasing ^0D.
2. Shannon-Weaver entropy ^1H of order q = 1 measures the uncertainty in observing a given intensity value when a pixel is randomly selected in the image. In economy, it corresponds to Theil's index. Such index put the same statistical weight on each pixel in the image. However, the information, $I = lb(1/p_i)$ brought by a given intensity is pondered by its probability p_i. This is the ecological index giving an idea of the total information necessary for a full description of a whole community. For an EPA image, ^1H is a measure of photo diversity considered as the total amount of information necessary for encoding the image without losses. If the image is uniform, there is no uncertainty at all ($^1H = 0$), whereas a maximum uncertainty ($^1H = 16$) is obtained for a perfectly random image. This is the most intuitive and neutral measure of photo-diversity as all intensities are taken into account: the rarest ones as well as the most frequent ones. The drawback is that this index totally ignores the possible existence of coherence between pixels. In contrast with ^0D, replacement of a frequent intensity by a rare one in a pixel increases entropy, if and only if it is a strictly concave function of the probability p_i.
3. The Shannon-Weaver diversity of order 1 (^1D) is the binary exponential of the corresponding entropy. It corresponds to the effective number of intensities that could be observed by considering many randomly chosen pixels. It then measures the number of gray levels that are the most frequently encountered.

For a uniform image one has $^1D = 2^0 = 1$, while for a random image one has $^1D = 2^{16} = 65536 = R$.

4. Pielou's evenness index is defined as: $^1E = {}^1H/lb(R)$. It is a measure of the deviation existing between the observed distribution of intensities and a uniform distribution of intensities. An image characterized by a single gray-level has $^1E = 0$, while in case of equal distribution of pixels among all possible gray-levels, one has $^1E = 1$. The regularity of the intensity's distribution is an important characteristic of an image that is different from its richness ^0D or its photo-diversity ^1D. Accordingly, a gray-level represented by a large number of pixels or by a single pixel does not bring the same contribution to the global image.
5. Simpson's concentration index $^2\lambda$ or generalized entropy of order 2, measures the probability that two randomly chosen pixels display the same intensity. Such index puts emphasis on correlation existing between pairs of pixels. This stems from the fact that rare intensities contribute only to a few pairs providing a negligible contribution to the index. Simpson's index tends towards zero for a uniform image and tends toward unity for a fully random image. It is characterized by a high sensitivity toward any variation affecting the most represented gray-levels of an image.
6. Simpson's diversity is defined as the reciprocal of the pair concentration index: $^2D = 1/{}^2\lambda$. It corresponds to the effective number of gray-levels that could be observed by selecting a great number of pixels among the most represented intensities. It gives an idea of the number of intensities that are frequently encountered inside an image.
7. Williams' evenness index of order two (^2E) seems to be the best way of measuring the regularity degree of a community [40]. It is related to Simpson's concentration index through the following relationship: $^2E = 1 - [(R\times{}^2\lambda - 1)/(R - 1)]^{1/2}$. It obeys the same rules as Pielou's index.
8. Berger-Parker's diversity ($^\infty D$, *i.e.* infinite order diversity) is a dominance index that corresponds to the inverse probability of the most frequent intensity. All other intensities are just ignored.
9. As photo-diversity drops considerably between order zero and one, we have also computed an intermediate half-order diversity ($^{1/2}D$) allowing plotting a smoother diversity profile. As $q < 1$, such diversity puts emphasis on intensities that not so frequently encountered in the image but that are nevertheless not very rare ($q > 0$).
10. Besides computing a diversity profile, one may also consider the L2-norm of the image defined as:

$$L2 = \sqrt{\sum_{i=1}^{N}\sum_{j=1}^{N} f(i,j)^2}$$

Here f(i,j) stands for the intensity of a given (i,j) pixel and N is, as before, the total number of pixels. The L2-norm gives an idea of the total photonic intensity and is expected to remain roughly constant for similar materials.

11. Our last index will be the H1-norm of the image defined as:

$$H1 = \sqrt{\sum_{i=1}^{N}\sum_{j=1}^{N} \begin{matrix} [f(i,j)-f(i-1,j+1)]^2 + [f(i,j)-f(i,j+1)]^2 + [f(i,j)-f(i+1,j+1)]^2 + \\ [f(i,j)-f(i-1,j)]^2 + [f(i,j)-f(i+1,j)]^2 + [f(i,j)-f(i-1,j-1)]^2 \\ + [f(i,j)-f(i,j-1)]^2 + [f(i,j)-f(i+1,j-1)]^2 \end{matrix}}$$

It provides a measure of the global average contrast existing between all the pixels of the image. As evidenced by the above formula, it compares the intensity of a given pixel to that of its 8 first-neighbors.

Each of these 11 indexes gives information on different aspects of the same image, providing a good global discrimination between apparently similar images to the naked eye. This allows comparing different images from an objective viewpoint, without referring to the details and how pixels tend to cluster together defining geometric shapes.

3.3 Contrast enhancement

The above global analysis has to be applied to the raw image as recorded by the CCD camera. The trouble is then that a CCD camera behaves linearly whereas the human eye behaves in a strongly non-linear way. It follows that the captured raw images appear, at first sight, quite monotonous with a low contrast, with a strong contribution coming from the unavoidable background noise of the camera. Hence the necessity of non-linear mathematical transformations of the image in order to increase contrast and reveal details that are difficult to perceive for a naked eye. The best-known and most fruitful mathematical procedure is obviously the spatial fast Fourier-transform (FFT). But it is also the most difficult to analyze intuitively as intensities now reflect the frequency spectrum of the image and no more the spatial disposition of the pixels.

Fortunately, one is not obliged to use FFT to increase contrast and reveal clusters of pixels defining geometrical shapes, which could be analyzed in terms of spatial extension and texture. In the following, we have used a set of 10 different algorithms for increasing contrast of EPA images. The first method uses an identity transformation that changes nothing in order to see the effect of the other transformation [41]. In the following, it has the label “Raw”. The second method (label “Auto”) tries to select a minimum intensity I_{min} and a maximum one I_{max} by setting an arbitrary noise and saturation threshold. For that purpose the histogram of intensity distribution is computed and binned to a 256 gray-level shades. All gray-levels having a population larger than 10% of the total number of pixels are retained. Starting with the index 0, all gray-levels having a population smaller than 0.02% of the total number of pixels are considered as noise, defining an I_{min} value on the 65 536 gray-levels histograms. Similarly, starting with the index 256, all gray-levels having a population smaller than 0.02% of the total number of pixels are considered as saturated, defining an I_{max} value on the 65 536 gray-levels histograms. From these two minimum and maximum values, intensities populations are reassigned according to the following rule:

$$\begin{cases} g(I) = 0 \; if \; I \leq Imin \\ g(I) = \dfrac{I - Imin}{Imax - Imin} \times (R-1) \quad if \quad Imin < I < Imax \\ g(I) = (R-1) \quad if \quad I \geq Imax \end{cases}$$

A third normalization method (label “Normal”) allows determination of I_{min} and I_{max} values by eliminating arbitrarily 2% of the leftmost and rightmost intensities of the histogram. The same transformation as before is then applied to get a transformed image. The fourth method (label “Median”) uses a median filter. This is a technique that causes minimal edge blurring, but that may remove isolated spikes and destroy fine lines [42]. The technique involves replacing the pixel value at each point in an image by the median of the pixel values in a neighborhood (here the 8 adjacent pixels) about the point without iterating the procedure. The contrast and the luminosity of the image is thus respected while eliminating extreme values. The fifth algorithm (label "Equal") uses the technique of histogram equalization (HE). This is a procedure that rescales the range of an image's pixel values to produce an enhanced image whose pixel intensities are more uniformly distributed. Consequently, all intensities in the transformed image are represented by about the same number of pixels. Contrast is thus increased at the most populated range of brightness values of the histogram (peaks) and automatically reduced in the very light or dark parts of the image associated with the tails of the histogram. The mathematical transformation involves computation of the cumulative histogram P(I) defined as:

$$P(I) = \sum_{i=0}^{I} n_i \Rightarrow g(I) = P(I)$$

However, such a transformation presupposes that it exists an approximate equality between the value g of a given pixel and the average gray level <g> of the image. In the case of CCD images, this is not true, as it exists a logarithmic relationship between the physical luminous intensity and the subjective interpretation of this intensity by the human brain. In 1834 Ernst Heinrich Weber (1795–1878) discovered that the just noticeable change in a stimulus increment dS is in constant proportion to the initial stimulus S: $\Delta S/S = K$. In other words, the stronger an initial stimulus I, the more significant the change in intensity has to be, in order to be perceived by an individual [43]. Such a law suggests a sixth algorithm (label "Weber") using an exponential correction consistent with Weber's law:

$$g(I) = (R-1)^{P(I)}$$

The German physicist and psychologist Gustav Theodor Fechner (1801-1887) has generalized Weber's law in 1860 by stating that the subjective perception of many different kinds of senses is proportional to the logarithm of the stimulus intensity $dI = K \cdot dS/S$ or $I = K \cdot \ln(S) + c$ (Weber-Fechner's law) [44]. This forms the basis of the hyperbolization algorithm (label "Hyper"), which has been designed to produces images with a uniform distribution of perceived brightness levels using an empirical constant c = 0.573 [45]:

$$g(I) = c \times \left[\left(1 + \frac{R-1}{c}\right)^{P(I)} - 1 \right]$$

Both transformations thus try to emphasize the image details, based on transformations made by the human peripheral system. It was however suggested that this system accommodates to the medium intensity <g> of the observed scene, and not to the individual pixel intensity as supposed in the two previous algorithms. A new algorithm named quadratic hyperbolization (label "Quad") add the further advantage to provide a larger distribution of the gray-levels, evicting an excessive concentration in the dark tons [46]:

$$g(I) = \frac{< g > \times (R-1) \times P(I)}{< g > \times (R-1) \times [1 - P(I)]}$$

Another drawback of the histogram equalization (HE) procedure is that it is efficient only if the original image displays a rather weak contrast. If this is not the case, the image quality may become strongly degraded. This is because nearly uniform regions in the image usually cause high peaks in the histogram. In ordinary HE-mapping, a limited range of input intensity values becomes mapped to a wide range of output intensity values, perhaps over-enhancing the noise. It thus exists an adaptive version (AHE) of the algorithm. AHE uses the HE mapping function supported over a certain size of a local window to determine each enhanced density value. It acts as a local operation. Therefore, regions occupying different gray scale ranges can be enhanced simultaneously. As the image may still lack contrast locally, the histogram modification needs to be applied to each pixel based on the histogram of pixels that are neighbors to a given pixel (contextual region). The image is thus partitioned into blocks of suitable size and the histogram is equalized at each sub-block. To eliminate artificial boundaries created by this process, the intensities are interpolated across the block regions using bi-cubic interpolating functions [47].

A contextual region is usually 1/16 ou 1/64 of the image area with the smaller region chosen only when the feature size of interest is quite small. With a smaller contextual region, the contrast becomes too sensitive to very local variations and in particular to image noise. Although AHE frequently produces excellent results, in certain cases, noise becomes disturbingly obvious. This may occur when the image includes relatively homogeneous regions or a poor signal to noise ratio. CLAHE (clipped or contrast-limited AHE) avoids this over-enhancement of noise [48]. CLAHE (Label "Clahe") is thus the ninth algorithm of image processing to be tested on EPA-images.

In CLAHE each pixel is mapped to intensity proportional to its rank in the pixels surrounding it. Contrast enhancement can be defined as the slope of the function mapping input intensity. If the range of input and output intensities are the same, then a slope of 1 involves no enhancement and higher slopes give increasingly higher enhancement. Enforcing a maximum on the contents of the histogram bins will then limit the amount of contrast enhancement and thus the enhancement of noise. However, when contrast enhancement is reduced at one location, it must be increased in other areas so that the entire input intensity range will be mapped to the entire output intensity range. This corresponds to renormalizing the histogram after clipping so that its area returns to its original value. The most effective way to redistribute the clipped pixels is to distribute them uniformly in all histogram bins.

Specifying a limit slope f thus determines a clipping limit C for the height of the histogram, which can be shown to be f times the average histogram bin content. Now, adding a uniform level L to the clipped histogram will push the clipped histogram again above the chosen clipping limit. This means that the original histogram needs to be clipped at a lower limit P such that P + L(P) is equal to the clipping limit. The adequate P-value may be found by a binary search for the largest intensity such that the area of the histogram above this level is not greater than the product of the total number of histogram bins and C minus this level. Having found the desired P, the modified histogram value v in any bin is calculated from the original value v_{org} by:

$$v = \begin{cases} v_{org} + L \ \ si \ \ v_{org} < P \\ C \ \ si \ \ v_{org} \geq P \end{cases}$$

For this preliminary study, contextual CLAHE regions was 4×4 or 8×8 sub-blocks of pixels with a limit slope f = 2. Testing larger contextual regions or other limit slope values would have been interesting, but also time-consuming.

The rolling-ball algorithm will be our tenth and last noise reduction procedure (label “Roll”). Here, the image is considered to be a stacking of oscillating signals and two balls having a fixed diameter are rolled above and below such oscillations [49]. Points that are touched by the upper ball or the lower ball thus defines two envelopes that may be used for computing the average high-frequency contribution of the noise that can be subtracted from the original image. Two images are then generated, the first one corresponding to a noisy high-frequency background and the second one that contains the details associated to low-frequency oscillations. For this preliminary study, we have used two balls having the same radius of 10, 20 or 30 pixels.

3.4 *Color enhancement*

Finest details become generally much more discernible by mapping gray-levels to 256-color palettes. For this study we have selected 12 palettes provided by the software ImageJ [50]. Figure 3 shows the rendering of the same gray image according to these twelve palettes for a tap water droplet. One of these palettes (GLASBEY) is based on the maximization of the dissimilarity or distance between a color and the adjacent colors [51]. This allows perceiving the maximum of details both inside and outside the corona. At the other extreme, we have the EDGES palette that removes all details except those centered on an interval centered on medium intensities. Such a palette allows visualizing a single average contour for the corona. Other palettes use look-up tables (LUTs) optimized for visualizing very fine details in the outer corona or revealing internal structure of the corona.

3.5 *Thresholding algorithms*

The last way of getting useful information from an EPA-image is to use thresholding techniques for generating binary images where intensity 0 is associated to background and intensity 1 to a foreground. This allows automatic counting of the total number of blobs in the image as well as determination of the geometric characteristics of such blobs. An exhaustive survey and categorization of 40 image thresholding techniques is available [52]. Among these numerous algorithms, one may distinguish between global and local adaptive thresholding methods. In a global algorithm, a single thresholding value is selected for the entire image. The disadvantages of these approaches are that they are not effective on images having varying levels of noise, complex structure or multiple illumination levels. In such cases, a local adaptive approach may be used where an independent threshold is determined for each pixel over a local window whose center is the pixel that should be binarized.

For this study, we have selected a set of fifteen global thresholding algorithms implemented into the Auto Threshold and Auto Local Threshold plugins of the ImageJ software [50]. Some are very fast and simple, while others are time-consuming for 16-bits images and more complex. Each selected algorithm has a label referring to the name of its principal author and/or developer. Here is a short description of each algorithm classified according to the year of development and implementation.

1. The percentile algorithm (Doyle [53]) assumes that the fraction of foreground pixels is p = 50% (median of the distribution of pixel values). With such a percentile, the threshold is set to the highest gray-level which maps at least (100 − p)% of the pixels into the object category.
2. The intermodes algorithm (Prewitt1 [54]) assumes a bimodal histogram, with one peak corresponding to the background and the other peak to the foreground. The histogram is smoothed (using a running average of size 3, iteratively) until there are only two local maxima j and k. The threshold is then defined as t = (j+k)/2. Images with histograms having extremely unequal peaks or a broad and flat valley are unsuitable for this method.
3. Similarly to the Intermodes method, the minimum algorithm (Prewitt2 [54) assumes a bimodal histogram. The histogram is iteratively smoothed using a running average of size 3, until there are only two local maxima. Threshold t is such that $p(t-1) > p(t) <= p(t+1)$, where p(i) is the number of pixels for a gray-level i. Again, images with histograms having extremely unequal peaks or a broad and flat valley are unsuitable for this method.
4. In the triangle algorithm (Zack [55]), one performs a normalization of the height and dynamic range of the intensity histogram. A triangle is then defined by the maximum height of the histogram and one of its extreme (p = 0) that is the furthest from the maximum. The threshold is then chosen as the point that maximizes the distance between the height on the histogram and its projection on the main diagonal of the triangle.
5. The iterative intermeans algorithm (Ridler [56,57]) assumes that the initial threshold is the mean of the entire histogram of the image. This allows computing the two means μ_0 and μ_1 for the two distributions on either side of the threshold, leading to a new threshold $t = (\mu_0 + \mu_1)/2$. The procedure is then repeated until convergence. Such a division of the histogram is optimal as it preserves the image average luminance [58].
6. The clustering algorithm (Otsu [59]) involves iterating through all the possible threshold values and calculating a measure of spread for the pixel levels each side of the threshold, i.e. the pixels that either fall in foreground or background. The aim is to find the threshold value where the sum of foreground and background spreads is at its minimum.
7. The moment preserving algorithm (Tsai [60]) chooses a threshold in such a way that the first 4 moments of the image are preserved after binarization.
8. The maximum entropy algorithm (Kapur [61]) separates the histogram in two probability distribution B[1,..,t] and F[t+1,…,R] and computes the entropy of both distributions H(B) and H(F) for all possible threshold values. The threshold t that maximizes the sum H(B) + H(F) then corresponds to the maximum information between the object and background in the image.
9. The minimum error algorithm (Kittler [62]) considers thresholding as a classification problem. Here, the minimum error threshold discriminating between background and foreground is obtained using statistical decision theory, assuming that respective populations are distributed normally with distinct means and standard deviations. The minimization is performed iteratively using the dynamic clustering algorithm.

10. The cross entropy algorithm (Li [63]) selects a threshold by minimizing the cross entropy between the image and its segmented version. This method provides an unbiased estimate of a binarized version of the image in an information theoretical sense. We have implemented the fast iterative version of this method [64].
11. The mean algorithm (Glasbey [65]) selects the threshold as being the integer part of the ratio between the moments of order 1 and order zero of the histogram.
12. The minimum fuzzy entropy algorithm (Shanbhag [66]) is a modification of Kapur's with a more pertinent information measure of the image. Let p(t) be the probability of occurrence of pixels with gray-level t and $k_X = 0.5/p(X)$ a constant associated with a set of pixels X having a probability p(X). The algorithm assumes that the function allowing deciding if a pixel with gray-level g belongs to background (X = B) or foreground (X = F) is $\mu_X(g) = 0.5 + k_X \times p(g)$. For each threshold t, the fuzzy entropy, $E(X) = -\sum_g p(g) \times \log[\mu_X(g)]/p(X)$ is then evaluated for both background (X = B, g ≤ t) and foreground (X = F, g > t). The gray-level that minimizes |E(B) – E(F)| is selected as a threshold for binarization.
13. The maximum correlation entropy algorithm (Yen [67]) is based on a measure of correlation for a set X, defined as $G(X,t) = -\sum_g [p(g)]^2$ for background (X = B, g ≤ t) or foreground (X = F, g > t). The correlation entropy is then evaluated as $C(t) = -\ln[G(B,t) \times G(F,t)] + 2 \times \ln[P(t) \times (1 - P(t)]$, where P(t) is the cumulative probability of the normalized histogram. The optimum threshold t is the gray-level that maximizes such correlation entropy.
14. The minimum fuzzy entropy algorithm (Huang [68]) is based on Shannon's function $S[\mu_X(g)] = -\mu_X(g) \times \ln[\mu_X(g)] - [1 - \mu_X(g) \times \ln[1 - \mu_X(g)]$ which is a measure of fuzziness of a pixel having a gray-level g and belonging to a given set X. Here, for a given threshold t, the set membership function deciding if a pixel having a gray-level f(i,j) belongs to the background (X = B, k = 0 when f(i,j) ≤ t) or to the foreground (X = F, k = 1 when f(i,j) < t) is $\mu_X[f(i,j)] = 1/(1 + |f(i,j) - \mu_k(t)|/C]$. The constant C is equal to the inverse of the dynamic range ($g_{max} - g_{min}$) of the image and $\mu_k(t)$ is the ratio between the moments of order 1 and order zero of the background and foreground pixels. The algorithm then looks for the threshold value t that minimizes the fuzzy entropy $E(X) = \sum_g S[\mu_X(g)] \cdot h(g)$ when g = 0, 1,…, R-1.
15. The last algorithm uses Kapur's maximum entropy method where three Renyi's generalized entropies ${}^qH$ (q < 1, q = 1 and q > 1) replaces Shannon's entropy (q = 1) [69]. This is the most sophisticated algorithm.

Concerning local adaptive thresholding techniques, five of them have been selected for this study. All these techniques are based on the use of windows that may be rectangular or circular.

1. Bernsen's thresholding algorithm uses a user-provided contrast threshold. [70,71]. If the local contrast (max-min within the radius of the pixel) is above or equal to the contrast threshold, the threshold is set at the local mid-gray value (the mean of the minimum and maximum gray values in the local window). If the local contrast is below the contrast threshold, the neighborhood is considered to consist only of one class and the pixel is set to foreground or background depending on the value of the mid-gray. In this study, the window size has been set 15×15 with a fixed contrast threshold of 15.

2. Niblack's thresholding algorithm [72] adapts the threshold according to the local mean m(i,j) and standard deviation σ(i,j) for a given window size W centered on pixel (i,j), using a bias setting k and an offset c-value. If the pixel gray-value g is larger than T(i,j) = m(i,j) + k×σ(i,j) − c, the pixel is affected to the foreground, otherwise it is labeled as background. The values W = 15, k = -0.2 and c = 0 have been selected for this study.
3. Sauvola's thresholding algorithm [73] is a refinement of Niblack's method by introducing a dynamic range DR of standard deviations. The discrimination criterion between background and foreground here becomes: T(i,j) = m(i,j) ×[1 + k×{σ(i,j)/DR − 1}. The values W = 15, k = 0.5 and DR = 128 have been selected for this study.
4. Phansalkar's algorithm [74] is a modification of Sauvola's method well suited to low contrast images. The discrimination criterion between background and foreground here becomes: T(i,j) = m(i,j)×[1 + p×exp{q×m(i,j)} + k×{σ(i,j)/DR − 1}. The values W = 15, k = 0.5, DR = 128, p = 2 and q = 10 have been selected for this study.
5. In Savakis' algorithm, each pixel is assigned to a background and foreground level using one of the 15 previously described global thresholding method. From there, the threshold value is determined by the average of two background/foreground clusters [75]. However, this algorithm runs slowly due to its re-computing threshold value of each central pixel in a local window W×W in size. Another algorithm optimized for speed allows retaining the quality of Savakis' binary image [76].

3.6 *Geometrical analysis*

After binarization of the EPA image into background pixels and foreground pixels, the final step is to perform a geometric analysis of the various shapes defined by the clustering of these pixels. The first step is to affect each pixel on the image a label ranging from 0 (background) to a value NCC corresponding to the total number of 8-connected components (CCs) found in the image. Then, all CCs that have a total number of pixels smaller than a fixed lower limit LIM = 1000 are not analyzed. For the remaining largest CCs, the following analysis is performed.

1. Besides the total number of pixels NPIX belonging to a given CC, the total area A is also evaluated for considering shapes with rough borders [77,78]. The width, height and aspect ratio of the box bounding the CC are also determined. Finally, evaluation of the central moments (μ_{00}, μ_{11}, μ_{20}, μ_{02}) of the CC allows retrieving the coordinates of its centroid. Two shape indexes are also evaluated, one for ellipticity IE and the other one for triangularity IT [79]. These two indexes are positive values peaking at 1 for a perfect ellipse or a perfect triangle.
2. Central moments may also be used for evaluation of the ellipse features of a CC [80]. This allows retrieving major and minor axis lengths, an aspect ratio, an eccentricity, an orientation and an equivalent diameter $D = (4A/\pi)^{1/2}$.
3. The previous parameters do not allow recognition of a shape if it has been translated, rotated or scaled. In fact, it is possible to compute six two-dimensional Hu's moments (ψ_1, ψ_2, ψ_3, ψ_4, ψ_5 and ψ_6,) referred to pair of uniquely determined principal axes that are absolute invariants under translation, similitude and orthogonal transformations of nay geometrical pattern [81]. It is also possible deriving four "affine moments" (I_1, I_2, I_3 and I_4) that are invariant under general

affine transformations [82]. Such a set of moments allows recognition of an object shape even if it has been affine-deformed. Formulas are also available for computing complete and independent affine moments of any order [82] and even for highly symmetrical shapes [84].

4. In order to get a finer characterization, the 8-connected contour of the CC has also been traced [85]. This allows you to get new information on the shape: the total pixel count of the contour and the coordinates of the four corners (upper-left, upper-right, bottom-left and bottom-right) of the minimum area-bounding rectangle (MBR).
5. Knowledge of the contour of the CC, allows retrieving its convex hull through Andrew's monotone chain 2D algorithm [86]. This allows further characterization of the contour in terms of area of its MBR, minimal width and maximal diameter using rotating calipers [87], solidity (ratio between object and hull areas), compactness (ratio between object's equivalent diameter and the maximum diameter of its contour), rectangularity (ratio between the area of the CC and the area of MBR), circularity (ratio between the mean of radial distances and the square root of the variance) and elliptic variance of the CC [79].
6. From the histogram of the radial distances distribution within the contour it is possible to retrieve the entropy and the roughness of the contour [88,89] as well as the normalized contour sequence moments [90].
7. As a contour is constituted of N segments, it is also possible retrieving a statistic (mean, variance, skewness, kurtosis) of the $n \times (n-1)/2$ unique chords dividing the CC in two parts.
8. Finally, an ellipse fitting of the contour is possible [91]. This allows retrieving coordinates for the center of the ellipse and its major and minor axes lengths, tilting angle, eccentricity and the standard deviation from the contour of the CC.

3.7 *Measured parameters*

To obtain these 13 indexes, we first need to calculate the necessary image parameters. This can be done on the global surface of the photos or on selected surfaces. A differentiated selection is made for the overall surface area of the black and white, colored and Fast Fourier Transform image. The FFT image is created by setting the emitted light intensities to a logarithmic scale. The center of the image corresponds to the largest spatial wavelength. Wavelengths become shorter and shorter towards the periphery.

For colored images, we additionally select the surface of the illuminated (outer) zone and the dark central surface. For FFT images, the outer surface, the most structured surface and the central rings.

Figure 3 shows an example of such selections. In practice 30 parameters are measured. 1) Area = Surface area of selected section in μm^2; 2) Mean = smooth the full image surface in pixel/cm^2; 3) StdDev = difference between highest and lowest pixel values; 4) Mode = Strip Byte Count (highest pixels' frequency peak) in pixel/cm^2; 5) Min = smooth the image with the smallest pixels' value in pixel/cm^2; 6) Max = smooth the image with the highest pixels' value in pixel/cm^2; 7) X = horizontal axis of the image in µm; 8) Y = vertical axis of the image in µm; 9) XM = brightness-weighted average of X in Lux (lumen/m^2); 10) YM = brightness-weighted average of Y in Lux (lumen/m^2); 11) Perim = length of the perimeter of the selected area in µm; 12) BX = horizontal axis of the smallest rectangle enclosing the selection in µm; 13) BY = vertical axis of the smallest rectangle enclosing the selection in µm; 14) Width = bottom side of the largest rectangle enclosed in the selection in µm; 15) Height = other side of the largest rectangle enclosed in the selection in µm; 16) Major = when the selection is an ellipse, primary axis in µm; 17) Minor = when the selection is an ellipse, secondary axis in µm; 18) Angle = when the selection is an ellipse, angle between primary axis and horizontality (X) in degree (max 180°); 19) Circ = 1 = perfect circle, lowering when turning in ellipse; 20) Feret = longest distance between 2 points in the selection in µm; 21) Median = median pixels value in the selection in pixel; 22) Skew = the third order moment about the mean (spatial) 0: symmetrical; >0: positive; <0: negative; 23) Kurt = the fourth order moment about the mean (spatial) 0: symmetrical; >0: positive; <0: negative; 24) FeretX = diameter of a circle around horizontal axis X in µm; 25) FeretY = diameter of a circle around vertical axis Y in µm; 26) FeretAngle = Feret angle compared with X in degree; 27) MinFeret = minimum diameter of a circle drawn between the smallest distance between 2 points in µm; 28) AR = aspect ratio obtained dividing major axis by minor axis; 29) Round = inverse value of AR; 30) Solidity = area surface divided by the convex area (convex hull area: largest area containing all pixels giving an idea of the surface homogenous distribution of pixels).

Detailed ANOVA spreadsheets

Three Way Analysis of Variance jeudi, février 06, 2025, 16:43:17

Data source: Data 1 in Notebook 1

Balanced Design (No Interactions)

Dependent Variable: **Area**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,233)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	118988114,083	118988114,083	6,915	0,034
Zone	1	541215576,750	541215576,750	31,454	<0,001
Sample	2	5958456,500	2979228,250	0,173	0,845
Residual	7	120445006,917	17206429,560		
Total	11	786607154,250	71509741,295		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,034). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,845).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	Diff of Means	t	P	P<0,050
Gels vs. Ethyl	6297,833	2,630	0,034	Yes

Comparisons for factor: **Zone**

Comparison	Diff of Means	t	P	P<0,050
1,000 vs. 2,000	13431,500	5,608	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,554
Power of performed test with alpha = 0,0500: for Zone : 0,997
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	4874,833
Gels	11172,667

Std Err of LS Mean = 1693,440

Least square means for Zone :

Group	Mean
1,000	14739,500
2,000	1308,000

Std Err of LS Mean = 1693,440

Least square means for Sample :

Group	Mean
1,000	7198,000
2,000	8919,750
3,000	7953,500

Std Err of LS Mean = 2074,032

Three Way Analysis of Variance jeudi, février 06, 2025, 16:48:12

Data source: Data 1 in Notebook 1

Balanced Design (No Interactions)

Dependent Variable: **Mean**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,506)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	2808406840,333	2808406840,333	15,368	0,006
Zone	1	7544064533,333	7544064533,333	41,281	<0,001
Sample	2	31393240,167	15696620,083	0,0859	0,919
Residual	7	1279245954,833	182749422,119		
Total	11	11663110568,667	1060282778,970		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,006). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,919).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Ethyl vs. Gels	30596,333	3,920	0,006	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	50146,667	6,425	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,899
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	81823,500
Gels	51227,167

Std Err of LS Mean = 5518,898

Least square means for Zone :

Group	**Mean**
1,000	91598,667
2,000	41452,000

Std Err of LS Mean = 5518,898

Least square means for Sample :

Group Mean

1,00068751,750

2,00065866,500

3,00064957,750

Std Err of LS Mean = 6759,242

Three Way Analysis of Variance jeudi, février 06, 2025, 16:51:06

Data source: Data 1 in Notebook 1

Balanced Design (No Interactions)

Dependent Variable: **StdDev**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,084)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	8114785,333	8114785,333	0,0323	0,862
Zone	1	4438668675,000	4438668675,000	17,660	0,004
Sample	2	21467647,167	10733823,583	0,0427	0,958
Residual	7	1759412610,167	251344658,595		
Total	11	6227663717,667	566151247,061		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,862).

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = 0,004). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,958).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	38465,000	4,202	0,004	Yes

Power of performed test with alpha = 0,0500: for Product : --
Power of performed test with alpha = 0,0500: for Zone : 0,936
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	46983,167
Gels	45338,500

Std Err of LS Mean = 6472,308

Least square means for Zone :

Group	**Mean**
1,000	65393,333
2,000	26928,333

Std Err of LS Mean = 6472,308

Least square means for Sample :

Group	**Mean**
1,000	46995,250

2,00044273,500
3,00047213,750
Std Err of LS Mean = 7926,927

Three Way Analysis of Variance jeudi, février 06, 2025, 16:53:18

Data source: Data 1 in Notebook 1

Balanced Design (No Interactions)

Dependent Variable: **Mode**

Normality Test (Kolmogorov-Smirnov): Failed (P < 0,050)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	34026,750	34026,750	6,619	0,037
Zone	1	56170,083	56170,083	10,927	0,013
Sample	2	94,500	47,250	0,00919	0,991
Residual	7	35984,917	5140,702		
Total	11	126276,250	11479,659		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,037). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = 0,013). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,991).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	Diff of Means	t	P	P<0,050
Gels vs. Ethyl	106,500	2,573	0,037	Yes

Comparisons for factor: **Zone**

Comparison	Diff of Means	t	P	P<0,050
1,000 vs. 2,000	136,833	3,306	0,013	Yes

Power of performed test with alpha = 0,0500: for Product : 0,533
Power of performed test with alpha = 0,0500: for Zone : 0,771
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	25,500
Gels	132,000

Std Err of LS Mean = 29,271

Least square means for Zone :

Group	Mean
1,000	147,167
2,000	10,333

Std Err of LS Mean = 29,271

Least square means for Sample :

Group Mean

1,00078,000

2,00082,500

3,00075,750

Std Err of LS Mean = 35,849

Three Way Analysis of Variance jeudi, février 06, 2025, 16:55:32

Data source: Data 1 in Notebook 1

Balanced Design (No Interactions)

Dependent Variable: **Min**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,172)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	21,333	21,333	224,000	<0,001
Zone	1	0,000	0,000	0,000	1,000
Sample	2	6,000	3,000	31,500	<0,001
Residual	7	0,667	0,0952		
Total	11	28,000	2,545		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 1,000).

The difference in the mean values among the different levels of Sample are greater than would be expected by chance after allowing for the effects of differences in Product and Zone. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Ethyl vs. Gels	2,667	14,967	<0,001	Yes

Comparisons for factor: **Sample**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 3,000	1,500	6,874	<0,001	Yes
2,000 vs. 3,000	1,500	6,874	<0,001	Yes
1,000 vs. 2,000	0,000	0,000	1,000	No

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : 1,000

Least square means for Product :

Group	**Mean**
Ethyl	8,333
Gels	5,667

Std Err of LS Mean = 0,126

Least square means for Zone :

Group Mean

1,0007,000
2,0007,000
Std Err of LS Mean = 0,126

Least square means for Sample :
Group Mean
1,0007,500
2,0007,500
3,0006,000
Std Err of LS Mean = 0,154

Three Way Analysis of Variance jeudi, février 06, 2025, 16:58:37

Data source: Data 1 in Notebook 1

Balanced Design (No Interactions)

Dependent Variable: **Max**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,547)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	6627,000	6627,000	5,856	0,046
Zone	1	35643,000	35643,000	31,497	<0,001
Sample	2	571,500	285,750	0,253	0,784
Residual	7	7921,500	1131,643		
Total	11	50763,000	4614,818		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,046). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,784).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	Diff of Means	t	P	P<0,050
Ethyl vs. Gels	47,000	2,420	0,046	Yes

Comparisons for factor: **Zone**

Comparison	Diff of Means	t	P	P<0,050
1,000 vs. 2,000	109,000	5,612	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,476
Power of performed test with alpha = 0,0500: for Zone : 0,997
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	224,000
Gels	177,000

Std Err of LS Mean = 13,733

Least square means for Zone :

Group	Mean
1,000	255,000
2,000	146,000

Std Err of LS Mean = 13,733

Least square means for Sample :

Group Mean

1,000210,250

2,000195,250

3,000196,000

Std Err of LS Mean = 16,820

Three Way Analysis of Variance jeudi, février 06, 2025, 17:00:42

Data source: Data 1 in Notebook 1

Balanced Design (No Interactions)

Dependent Variable: **X**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,085)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	105,021	105,021	29,381	<0,001
Zone	1	7,521	7,521	2,104	0,190
Sample	2	12,667	6,333	1,772	0,238
Residual	7	25,021	3,574		
Total	11	150,229	13,657		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,190).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,238).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Ethyl vs. Gels	5,917	5,420	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,995
Power of performed test with alpha = 0,0500: for Zone : 0,149
Power of performed test with alpha = 0,0500: for Sample : 0,135

Least square means for Product :

Group	**Mean**
Ethyl	246,500
Gels	240,583

Std Err of LS Mean = 0,772

Least square means for Zone :

Group	**Mean**
1,000	242,750
2,000	244,333

Std Err of LS Mean = 0,772

Least square means for Sample :

Group	**Mean**
1,000	244,875

2,000243,375
3,000242,375
Std Err of LS Mean = 0,945

Three Way Analysis of Variance jeudi, février 06, 2025, 17:03:45

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Y**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,612)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	3,521	3,521	1,473	0,264
Zone	1	0,188	0,188	0,0785	0,787
Sample	2	2,792	1,396	0,584	0,583
Residual	7	16,729	2,390		
Total	11	23,229	2,112		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,264).

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,787).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,583).

Power of performed test with alpha = 0,0500: for Product : 0,0919
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :
Group Mean
Ethyl271,750
Gels 272,833
Std Err of LS Mean = 0,631

Least square means for Zone :
Group Mean
1,000272,417
2,000272,167
Std Err of LS Mean = 0,631

Least square means for Sample :
Group Mean
1,000272,750
2,000272,500
3,000271,625
Std Err of LS Mean = 0,773

Three Way Analysis of Variance jeudi, février 06, 2025, 17:05:28

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **XM**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,417)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	126,042	126,042	27,566	0,001
Zone	1	0,119	0,119	0,0259	0,877
Sample	2	11,004	5,502	1,203	0,355
Residual	7	32,007	4,572		
Total	11	169,172	15,379		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,877).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,355).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Ethyl vs. Gels	6,482	5,250	0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,992
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : 0,0710

Least square means for Product :
Group Mean
Ethyl246,834
Gels 240,353
Std Err of LS Mean = 0,873

Least square means for Zone :
Group Mean
1,000243,494
2,000243,693
Std Err of LS Mean = 0,873

Least square means for Sample :
Group Mean
1,000244,888

2,000243,292
3,000242,601
Std Err of LS Mean = 1,069

Three Way Analysis of Variance jeudi, février 06, 2025, 17:08:21

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **YM**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,514)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	17,412	17,412	3,750	0,094
Zone	1	1,582	1,582	0,341	0,578
Sample	2	2,950	1,475	0,318	0,738
Residual	7	32,505	4,644		
Total	11	54,449	4,950		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,094).

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,578).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,738).

Power of performed test with alpha = 0,0500: for Product : 0,300
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	270,875
Gels	273,284

Std Err of LS Mean = 0,880

Least square means for Zone :

Group	Mean
1,000	272,443
2,000	271,716

Std Err of LS Mean = 0,880

Least square means for Sample :

Group	Mean
1,000	272,311
2,000	272,537
3,000	271,391

Std Err of LS Mean = 1,077

Three Way Analysis of Variance jeudi, février 06, 2025, 17:09:58

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Perim**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,256)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	30000,600	30000,600	9,145	0,019
Zone	1	256052,530	256052,530	78,054	<0,001
Sample	2	937,807	468,904	0,143	0,869
Residual	7	22963,179	3280,454		
Total	11	309954,117	28177,647		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,019). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,869).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Gels vs. Ethyl	100,001	3,024	0,019	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	292,149	8,835	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,689
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	223,858
Gels	323,859

Std Err of LS Mean = 23,383

Least square means for Zone :

Group	**Mean**
1,000	419,933
2,000	127,784

Std Err of LS Mean = 23,383

Least square means for Sample :
Group Mean
1,000261,964
2,000283,140
3,000276,471
Std Err of LS Mean = 28,638

Three Way Analysis of Variance jeudi, février 06, 2025, 17:12:11

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **BX**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,507)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	1408,333	1408,333	15,974	0,005
Zone	1	6912,000	6912,000	78,397	<0,001
Sample	2	57,167	28,583	0,324	0,733
Residual	7	617,167	88,167		
Total	11	8994,667	817,697		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,005). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,733).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Ethyl vs. Gels	21,667	3,997	0,005	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
2,000 vs. 1,000	48,000	8,854	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,910
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	210,500
Gels	188,833

Std Err of LS Mean = 3,833

Least square means for Zone :

Group	**Mean**
1,000	175,667
2,000	223,667

Std Err of LS Mean = 3,833

Least square means for Sample :
Group Mean
1,000202,750
2,000198,250
3,000198,000
Std Err of LS Mean = 4,695

Three Way Analysis of Variance jeudi, février 06, 2025, 17:14:13

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **BY**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,571)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	675,000	675,000	8,612	0,022
Zone	1	6440,333	6440,333	82,167	<0,001
Sample	2	38,000	19,000	0,242	0,791
Residual	7	548,667	78,381		
Total	11	7702,000	700,182		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,022). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,791).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Ethyl vs. Gels	15,000	2,935	0,022	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
2,000 vs. 1,000	46,333	9,065	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,660
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	236,500
Gels	221,500

Std Err of LS Mean = 3,614

Least square means for Zone :

Group	**Mean**
1,000	205,833
2,000	252,167

Std Err of LS Mean = 3,614

Least square means for Sample :

Group Mean

1,000231,500

2,000227,500

3,000228,000

Std Err of LS Mean = 4,427

Three Way Analysis of Variance jeudi, février 06, 2025, 17:16:37

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Width**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,268)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	2976,750	2976,750	8,411	0,023
Zone	1	25854,083	25854,083	73,051	<0,001
Sample	2	78,000	39,000	0,110	0,897
Residual	7	2477,417	353,917		
Total	11	31386,250	2853,295		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,023). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,897).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Gels vs. Ethyl	31,500	2,900	0,023	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	92,833	8,547	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,648
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	72,000
Gels	103,500

Std Err of LS Mean = 7,680

Least square means for Zone :

Group	**Mean**
1,000	134,167
2,000	41,333

Std Err of LS Mean = 7,680

Least square means for Sample :
Group Mean
1,00084,250
2,00090,250
3,00088,750
Std Err of LS Mean = 9,406

Three Way Analysis of Variance jeudi, février 06, 2025, 17:18:54

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Height**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,265)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	3104,083	3104,083	9,906	0,016
Zone	1	26040,083	26040,083	83,097	<0,001
Sample	2	115,167	57,583	0,184	0,836
Residual	7	2193,583	313,369		
Total	11	31452,917	2859,356		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,016). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,836).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Gels vs. Ethyl	32,167	3,147	0,016	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	93,167	9,116	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,726
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	70,500
Gels	102,667

Std Err of LS Mean = 7,227

Least square means for Zone :

Group	**Mean**
1,000	133,167
2,000	40,000

Std Err of LS Mean = 7,227

Least square means for Sample :

Group Mean

1,00082,500

2,00090,000

3,00087,250

Std Err of LS Mean = 8,851

Three Way Analysis of Variance jeudi, février 06, 2025, 17:20:34

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Major**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,261)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	3084,525	3084,525	8,978	0,020
Zone	1	25964,952	25964,952	75,577	<0,001
Sample	2	74,617	37,309	0,109	0,899
Residual	7	2404,905	343,558		
Total	11	31528,999	2866,273		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,020). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,899).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Gels vs. Ethyl	32,065	2,996	0,020	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	93,032	8,693	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,680
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	72,120
Gels	104,185

Std Err of LS Mean = 7,567

Least square means for Zone :

Group	**Mean**
1,000	134,668
2,000	41,636

Std Err of LS Mean = 7,567

Least square means for Sample :
Group Mean
1,00084,783
2,00090,739
3,00088,934
Std Err of LS Mean = 9,268

Three Way Analysis of Variance jeudi, février 06, 2025, 17:22:30

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Minor**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,277)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	3010,012	3010,012	9,389	0,018
Zone	1	25919,572	25919,572	80,846	<0,001
Sample	2	117,898	58,949	0,184	0,836
Residual	7	2244,217	320,602		
Total	11	31291,699	2844,700		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,018). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,836).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	Diff of Means	t	P	P<0,050
Gels vs. Ethyl	31,675	3,064	0,018	Yes

Comparisons for factor: **Zone**

Comparison	Diff of Means	t	P	P<0,050
1,000 vs. 2,000	92,951	8,991	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,701
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	70,368
Gels	102,043

Std Err of LS Mean = 7,310

Least square means for Zone :

Group	Mean
1,000	132,681
2,000	39,730

Std Err of LS Mean = 7,310

Least square means for Sample :

Group Mean

1,00082,032

2,00089,585

3,00087,001

Std Err of LS Mean = 8,953

Three Way Analysis of Variance jeudi, février 06, 2025, 17:23:48

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Angle**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,091)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	2700,000	2700,000	1,077	0,334
Zone	1	0,000	0,000	0,000	1,000
Sample	2	1350,000	675,000	0,269	0,772
Residual	7	17550,000	2507,143		
Total	11	21600,000	1963,636		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,334).

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 1,000).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,772).

Power of performed test with alpha = 0,0500: for Product : 0,0567
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :
Group Mean
Ethyl 15,000
Gels 45,000
Std Err of LS Mean = 20,442

Least square means for Zone :
Group Mean
1,00030,000
2,00030,000
Std Err of LS Mean = 20,442

Least square means for Sample :
Group Mean
1,00022,500
2,00045,000
3,00022,500
Std Err of LS Mean = 25,036

Three Way Analysis of Variance jeudi, février 06, 2025, 17:25:25

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Circ**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,485)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	10,0000101 0,0000101			2,951	0,130
Zone	10,000006750,00000675			1,976	0,203
Sample	20,000008170,00000408			1,195	0,358
Residual	70,00002390,00000342				
Total	110,00004890,00000445				

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,130).

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,203).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,358).

Power of performed test with alpha = 0,0500: for Product : 0,228
Power of performed test with alpha = 0,0500: for Zone : 0,138
Power of performed test with alpha = 0,0500: for Sample : 0,0702

Least square means for Product :
Group Mean
Ethyl0,998
Gels 1,000
Std Err of LS Mean = 0,000755

Least square means for Zone :
Group Mean
1,0001,000
2,0000,998
Std Err of LS Mean = 0,000755

Least square means for Sample :
Group Mean
1,0000,999
2,0001,000
3,0000,998
Std Err of LS Mean = 0,000924

Three Way Analysis of Variance jeudi, février 06, 2025, 17:26:56

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Feret**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,256)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	3072,000	3072,000	8,906	0,020
Zone	1	25947,000	25947,000	75,224	<0,001
Sample	2	76,167	38,083	0,110	0,897
Residual	7	2414,500	344,929		
Total	11	31509,667	2864,515		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,020). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,897).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Gels vs. Ethyl	32,000	2,984	0,020	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	93,000	8,673	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,676
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	72,167
Gels	104,167

Std Err of LS Mean = 7,582

Least square means for Zone :

Group	**Mean**
1,000	134,667
2,000	41,667

Std Err of LS Mean = 7,582

Least square means for Sample :
Group Mean
1,00084,750
2,00090,750
3,00089,000
Std Err of LS Mean = 9,286

Three Way Analysis of Variance jeudi, février 06, 2025, 17:28:50

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Median**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,779)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	5002,083	5002,083	49,080	<0,001
Zone	1	4218,750	4218,750	41,394	<0,001
Sample	2	52,667	26,333	0,258	0,779
Residual	7	713,417	101,917		
Total	11	9986,917	907,902		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,779).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	Diff of Means	t	P	P<0,050
Ethyl vs. Gels	40,833	7,006	<0,001	Yes

Comparisons for factor: **Zone**

Comparison	Diff of Means	t	P	P<0,050
1,000 vs. 2,000	37,500	6,434	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	74,333
Gels	33,500

Std Err of LS Mean = 4,121

Least square means for Zone :

Group	Mean
1,000	72,667
2,000	35,167

Std Err of LS Mean = 4,121

Least square means for Sample :

Group Mean

1,00056,750

2,00053,250

3,00051,750

Std Err of LS Mean = 5,048

Three Way Analysis of Variance jeudi, février 06, 2025, 17:30:53

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Skew**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,204)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	3,239	3,239	15,605	0,006
Zone	1	0,769	0,769	3,706	0,096
Sample	2	0,00285	0,00143	0,00687	0,993
Residual	7	1,453	0,208		
Total	11	5,463	0,497		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,006). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,096).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,993).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Gels vs. Ethyl	1,039	3,950	0,006	Yes

Power of performed test with alpha = 0,0500: for Product : 0,904
Power of performed test with alpha = 0,0500: for Zone : 0,296
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	0,584
Gels	1,623

Std Err of LS Mean = 0,186

Least square means for Zone :

Group	**Mean**
1,000	0,850
2,000	1,357

Std Err of LS Mean = 0,186

Least square means for Sample :

Group	**Mean**
1,000	1,097

2,000	1,088
3,000	1,125

Std Err of LS Mean = 0,228

Three Way Analysis of Variance jeudi, février 06, 2025, 17:32:45

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Kurt**

Normality Test (Kolmogorov-Smirnov): Failed (P < 0,050)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	22,822	22,822	7,714	0,027
Zone	1	17,543	17,543	5,930	0,045
Sample	2	0,0435	0,0217	0,00735	0,993
Residual	7	20,709	2,958		
Total	11	61,118	5,556		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,027). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = 0,045). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,993).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	Diff of Means	t	P	P<0,050
Gels vs. Ethyl	2,758	2,777	0,027	Yes

Comparisons for factor: **Zone**

Comparison	Diff of Means	t	P	P<0,050
2,000 vs. 1,000	2,418	2,435	0,045	Yes

Power of performed test with alpha = 0,0500: for Product : 0,606
Power of performed test with alpha = 0,0500: for Zone : 0,482
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	-0,361
Gels	2,397

Std Err of LS Mean = 0,702

Least square means for Zone :

Group	Mean
1,000	-0,191
2,000	2,227

Std Err of LS Mean = 0,702

Least square means for Sample :

Group	**Mean**
1,000	1,065
2,000	1,057
3,000	0,933

Std Err of LS Mean = 0,860

Three Way Analysis of Variance jeudi, février 06, 2025, 17:34:20

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **FeretX**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,259)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	336,021	336,021	0,340	0,578
Zone	1	3383,521	3383,521	3,425	0,107
Sample	2	732,667	366,333	0,371	0,703
Residual	7	6915,521	987,932		
Total	11	11367,729	1033,430		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,578).

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,107).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,703).

Power of performed test with alpha = 0,0500: for Product : --
Power of performed test with alpha = 0,0500: for Zone : 0,271
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	219,333
Gels	208,750

Std Err of LS Mean = 12,832

Least square means for Zone :

Group	**Mean**
1,000	197,250
2,000	230,833

Std Err of LS Mean = 12,832

Least square means for Sample :

Group	**Mean**
1,000	221,875
2,000	216,875
3,000	203,375

Std Err of LS Mean = 15,716

Three Way Analysis of Variance jeudi, février 06, 2025, 17:35:51

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **FeretY**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,462)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	462,521	462,521	0,554	0,481
Zone	1	652,688	652,688	0,781	0,406
Sample	2	571,500	285,750	0,342	0,722
Residual	7	5848,854	835,551		
Total	11	7535,563	685,051		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,481).

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,406).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,722).

Power of performed test with alpha = 0,0500: for Product : --
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	280,667
Gels	293,083

Std Err of LS Mean = 11,801

Least square means for Zone :

Group	**Mean**
1,000	294,250
2,000	279,500

Std Err of LS Mean = 11,801

Least square means for Sample :

Group	**Mean**
1,000	292,125
2,000	291,375
3,000	277,125

Std Err of LS Mean = 14,453

Three Way Analysis of Variance jeudi, février 06, 2025, 17:37:25

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **FeretAngle**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,091)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	2700,000	2700,000	1,077	0,334
Zone	1	0,000	0,000	0,000	1,000
Sample	2	1350,000	675,000	0,269	0,772
Residual	7	17550,000	2507,143		
Total	11	21600,000	1963,636		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,334).

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 1,000).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,772).

Power of performed test with alpha = 0,0500: for Product : 0,0567
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	15,000
Gels	45,000

Std Err of LS Mean = 20,442

Least square means for Zone :

Group	**Mean**
1,000	30,000
2,000	30,000

Std Err of LS Mean = 20,442

Least square means for Sample :

Group	**Mean**
1,000	22,500
2,000	45,000
3,000	22,500

Std Err of LS Mean = 25,036

Three Way Analysis of Variance jeudi, février 06, 2025, 17:38:53

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **MinFeret**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,274)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	3008,333	3008,333	9,394	0,018
Zone	1	25947,000	25947,000	81,024	<0,001
Sample	2	116,667	58,333	0,182	0,837
Residual	7	2241,667	320,238		
Total	11	31313,667	2846,697		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,018). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,837).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
Gels vs. Ethyl	31,667	3,065	0,018	Yes

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
1,000 vs. 2,000	93,000	9,001	<0,001	Yes

Power of performed test with alpha = 0,0500: for Product : 0,701
Power of performed test with alpha = 0,0500: for Zone : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Ethyl	70,333
Gels	102,000

Std Err of LS Mean = 7,306

Least square means for Zone :

Group	**Mean**
1,000	132,667
2,000	39,667

Std Err of LS Mean = 7,306

Least square means for Sample :

Group	Mean
1,000	82,000
2,000	89,500
3,000	87,000

Std Err of LS Mean = 8,948

Three Way Analysis of Variance jeudi, février 06, 2025, 17:41:23

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **AR**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,408)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	0,000208	0,000208	0,433	0,531
Zone	1	0,00347	0,00347	7,214	0,031
Sample	2	0,00326	0,00163	3,389	0,093
Residual	7	0,00337	0,000481		
Total	11	0,0103	0,000936		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,531).

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = 0,031). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,093).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Zone**

Comparison	**Diff of Means**	**t**	**P**	**P<0,050**
2,000 vs. 1,000	0,0340	2,686	0,031	Yes

Power of performed test with alpha = 0,0500: for Product : --
Power of performed test with alpha = 0,0500: for Zone : 0,574
Power of performed test with alpha = 0,0500: for Sample : 0,333

Least square means for Product :

Group	**Mean**
Ethyl	1,036
Gels	1,028

Std Err of LS Mean = 0,00895

Least square means for Zone :

Group	**Mean**
1,000	1,015
2,000	1,049

Std Err of LS Mean = 0,00895

Least square means for Sample :

Group	**Mean**
1,000	1,055

2,000	1,016
3,000	1,025

Std Err of LS Mean = 0,0110

Three Way Analysis of Variance jeudi, février 06, 2025, 17:42:59

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Round**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,435)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	0,000147	0,000147	0,388	0,553
Zone	1	0,00295	0,00295	7,769	0,027
Sample	2	0,00253	0,00126	3,334	0,096
Residual	7	0,00265	0,000379		
Total	11	0,00827	0,000752		

The difference in the mean values among the different levels of Product are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Zone and Sample. There is not a statistically significant difference (P = 0,553).

The difference in the mean values among the different levels of Zone are greater than would be expected by chance after allowing for the effects of differences in Product and Sample. There is a statistically significant difference (P = 0,027). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,096).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Zone**

Comparison	Diff of Means	t	P	P<0,050
1,000 vs. 2,000	0,0313	2,787	0,027	Yes

Power of performed test with alpha = 0,0500: for Product : --
Power of performed test with alpha = 0,0500: for Zone : 0,610
Power of performed test with alpha = 0,0500: for Sample : 0,326

Least square means for Product :

Group	Mean
Ethyl	0,967
Gels	0,974

Std Err of LS Mean = 0,00795

Least square means for Zone :

Group	Mean
1,000	0,986
2,000	0,954

Std Err of LS Mean = 0,00795

Least square means for Sample :

Group	Mean
1,000	0,950

2,000	0,984
3,000	0,976

Std Err of LS Mean = 0,00974

Three Way Analysis of Variance jeudi, février 06, 2025, 17:44:39

Data source: Data 1 in FIRE_ANOVA_3w.SNB

Balanced Design (No Interactions)

Dependent Variable: **Solidity**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,150)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	0,000147	0,000147	6,506	0,038
Zone	1	0,00000833	0,00000833	0,369	0,563
Sample	2	0,0000162	0,00000808	0,358	0,711
Residual	7	0,000158	0,0000226		
Total	11	0,000330	0,0000300		

The difference in the mean values among the different levels of Product are greater than would be expected by chance after allowing for the effects of differences in Zone and Sample. There is a statistically significant difference (P = 0,038). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Zone are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Sample. There is not a statistically significant difference (P = 0,563).

The difference in the mean values among the different levels of Sample are not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product and Zone. There is not a statistically significant difference (P = 0,711).

All Pairwise Multiple Comparison Procedures (Holm-Sidak method):
Overall significance level = 0,05

Comparisons for factor: **Product**

Comparison	Diff of Means	t	P	P<0,050
Gels vs. Ethyl	0,00700	2,551	0,038	Yes

Power of performed test with alpha = 0,0500: for Product : 0,525
Power of performed test with alpha = 0,0500: for Zone : --
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Ethyl	0,996
Gels	1,003

Std Err of LS Mean = 0,00194

Least square means for Zone :

Group	Mean
1,000	0,998
2,000	1,000

Std Err of LS Mean = 0,00194

Least square means for Sample :

Group	Mean
1,000	1,001

2,000	0,998
3,000	0,999

Std Err of LS Mean = 0,00238

Two Way Analysis of Variance lundi, mai 19, 2025, 08:48:33

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Area**

Normality Test (Kolmogorov-Smirnov): Passed (P = 0,121)

Equal Variance Test (Brown-Forsythe): Passed (P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	110742288,167	110742288,167	1052,136	<0,001
Sample	11	1639125,333	149011,394	1,416	0,287
Residual	11	1157801,833	105254,712		
Total	23	113539215,333	4936487,623		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,287).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,132

Least square means for Product :

Group	**Mean**
Tap water	5354,917
Gelsemium	1058,750

Std Err of LS Mean = 93,655

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	3265,000	229,407
2,000	3473,500	229,407
3,000	2908,500	229,407
4,000	3386,500	229,407
5,000	3520,000	229,407
6,000	3117,500	229,407
7,000	2980,000	229,407
8,000	2731,000	229,407
9,000	3605,000	229,407
10,000	2972,000	229,407
11,000	3161,000	229,407
12,000	3362,000	229,407

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	4296,167		245,872	<0,001	Yes

Two Way Analysis of Variance lundi, mai 19, 2025, 08:50:24

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Mean**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,190)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	2,406E+013	2,406E+0133708,908		<0,001
Sample	1198115609345,3338919600849,576			1,375	0,303
Residual	1171359776429,3336487252402,667				
Total	23	2,423E+013	1,053E+012		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,303).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,123

Least square means for Product :

Group	**Mean**
Tap water	2038894,000
Gelsemium	36369,667

Std Err of LS Mean = 23250,900

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	1115471,500	56952,842
2,000	977126,000	56952,842
3,000	957898,500	56952,842
4,000	1005176,000	56952,842
5,000	1033079,000	56952,842
6,000	977199,500	56952,842
7,000	994880,500	56952,842
8,000	1127400,000	56952,842
9,000	994258,000	56952,842
10,000	1037269,000	56952,842
11,000	1161908,000	56952,842
12,000	1069916,000	56952,842

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	2002524,333		286,127	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:51:38

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **StdDev**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,300)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	5,598E+012	5,598E+012	125,222	<0,001
Sample	11	521904248692,833	47445840790,258	1,061	0,462
Residual	11	491709224974,333	44700838634,030		
Total	23	6,611E+012	287441002869,471		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,462).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0601

Least square means for Product :

Group	**Mean**
Tap water	986969,417
Gelsemium	21090,750

Std Err of LS Mean = 61033,351

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	658416,000	149500,566
2,000	514470,000	149500,566
3,000	328319,500	149500,566
4,000	404613,000	149500,566
5,000	428199,000	149500,566
6,000	393871,000	149500,566
7,000	319194,500	149500,566
8,000	650393,500	149500,566
9,000	476661,500	149500,566
10,000	430248,000	149500,566
11,000	825849,500	149500,566
12,000	618125,500	149500,566

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	965878,667	2	15,825	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:52:32

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Mode**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,061)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	780,957	780,957	38,447	<0,001
Sample	11	223,527	20,321	1,000	0,500

Residual	11	223,441	20,313
Total	23	1227,926	53,388

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,500).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0501

Least square means for Product :

Group	**Mean**
Tap water	1,675
Gelsemium	13,083

Std Err of LS Mean = 1,301

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	4,830	3,187
2,000	7,792	3,187
3,000	4,337	3,187
4,000	3,856	3,187
5,000	5,856	3,187
6,000	7,824	3,187
7,000	15,336	3,187
8,000	7,421	3,187
9,000	4,292	3,187
10,000	8,856	3,187
11,000	8,824	3,187
12,000	9,324	3,187

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Gelsemium vs. Tap water	11,409	2	8,769	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:53:28

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Min**

Normality Test (Kolmogorov-Smirnov): Failed(P < 0,050)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	129,707	129,707	72,337	<0,001
Sample	11	19,961	1,815	1,012	0,492
Residual	11	19,724	1,793		
Total	23	169,393	7,365		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,492).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0519

Least square means for Product :

Group	**Mean**
Tap water	1,517
Gelsemium	6,167

Std Err of LS Mean = 0,387

Least square means for Sample :

Group	**Mean**
1,000	4,283
2,000	3,217
3,000	3,231
4,000	2,266
5,000	3,761
6,000	3,766
7,000	4,260
8,000	3,295
9,000	3,244
10,000	5,260
11,000	5,760
12,000	3,762

Std Err of LS Mean = 0,947

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Gelsemium vs. Tap water	4,649		212,028	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:54:22

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Max**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,103)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	58377,421	58377,421	42,339	<0,001
Sample	11	15329,225	1393,566	1,011	0,493
Residual	11	15166,922	1378,811		
Total	23	88873,567	3864,068		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,493).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0517

Least square means for Product :

Group	**Mean**
Tap water	18,195
Gelsemium	116,833

Std Err of LS Mean = 10,719

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	94,150	26,257
2,000	49,179	26,257
3,000	38,172	26,257
4,000	32,492	26,257
5,000	86,645	26,257
6,000	90,285	26,257
7,000	95,982	26,257
8,000	44,984	26,257
9,000	40,430	26,257
10,000	51,769	26,257
11,000	97,754	26,257
12,000	88,324	26,257

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Gelsemium vs. Tap water	98,639	2	9,202	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:56:24

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **X**

Normality Test (Kolmogorov-Smirnov):   Passed(P = 0,458)

Equal Variance Test (Brown-Forsythe):   Passed(P = 1,000)

Source of Variation	**DF SS MS**	**F**	**P**
Product	169039293822,04269039293822,042	143,625	<0,001
Sample	114663758154,458423978014,042	0,882	0,581
Residual	115287603904,458480691264,042		
Total	2378990655880,9583434376342,650		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,581).

Power of performed test with alpha = 0,0500: for Product : 1,000

Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Tap water	208893,583
Gelsemium	101625,000

Std Err of LS Mean = 6329,108

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	153341,000	15503,085
2,000	166305,500	15503,085
3,000	170565,500	15503,085
4,000	169029,000	15503,085
5,000	136515,000	15503,085
6,000	162341,500	15503,085
7,000	138017,500	15503,085
8,000	165862,500	15503,085
9,000	166807,500	15503,085
10,000	163177,500	15503,085
11,000	135431,500	15503,085
12,000	135717,500	15503,085

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	107268,583		216,948	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:57:11

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Y**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,118)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF SS MS**	**F**	**P**
Product	1218337982443,375218337982443,375311,716		<0,001
Sample	113343507587,125303955235,193	0,434	0,909
Residual	117704819837,125700438167,011		
Total	23229386309867,6259973317820,332		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,909).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Tap water	292385,750

Gelsemium	101625,000

Std Err of LS Mean = 7640,016

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	197817,500	18714,141
2,000	204718,000	18714,141
3,000	211396,000	18714,141
4,000	209039,000	18714,141
5,000	179983,000	18714,141
6,000	197478,500	18714,141
7,000	176392,500	18714,141
8,000	200873,000	18714,141
9,000	209108,500	18714,141
10,000	206888,500	18714,141
11,000	186956,000	18714,141
12,000	183414,000	18714,141

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	190760,750	2	24,969	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:57:50

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **XM**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,404)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	70811660703,375	70811660703,375	147,814	<0,001
Sample	11	4691160932,458	426469175,678	0,890	0,575
Residual	11	5269659206,125	479059927,830		
Total	23	80772480841,958	3511846993,129		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,575).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Tap water	209456,833
Gelsemium	100820,083

Std Err of LS Mean = 6318,359

Least square means for Sample :

Group	**Mean**	**SEM**

1,000	152898,500	15476,756
2,000	166525,500	15476,756
3,000	170153,500	15476,756
4,000	168530,500	15476,756
5,000	136352,000	15476,756
6,000	163205,500	15476,756
7,000	136810,000	15476,756
8,000	166195,000	15476,756
9,000	166564,000	15476,756
10,000	162683,500	15476,756
11,000	135993,500	15476,756
12,000	135750,000	15476,756

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	108636,750	217,194		<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:58:26

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **YM**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,175)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1218692941588,375218692941588,375308,451				<0,001
Sample	113389273531,458308115775,587			0,435	0,909
Residual	117799036325,125709003302,284				
Total	23229881251444,9589994837019,346				

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,909).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Tap water	291778,917
Gelsemium	100863,167

Std Err of LS Mean = 7686,586

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	196116,500	18828,214
2,000	206183,500	18828,214
3,000	211898,000	18828,214
4,000	208336,000	18828,214
5,000	179516,000	18828,214

6,000	196127,000	18828,214
7,000	177250,500	18828,214
8,000	199575,000	18828,214
9,000	207571,000	18828,214
10,000	205972,000	18828,214
11,000	186200,000	18828,214
12,000	181107,000	18828,214

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	190915,750		224,838	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:59:07

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: Perim.

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,051)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF SS MS**	**F**	**P**
Product	1158579069110,042158579069110,042872,278		<0,001
Sample	112714443970,458246767633,678	1,357	0,311
Residual	111999785943,458181798722,133		
Total	23163293299023,9587099708653,216		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,311).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,119

Least square means for Product :

Group	**Mean**
Tap water	277513,833
Gelsemium	114941,250

Std Err of LS Mean = 3892,286

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	201749,500	9534,116
2,000	210014,500	9534,116
3,000	183715,500	9534,116
4,000	203874,000	9534,116
5,000	206406,000	9534,116
6,000	199905,500	9534,116
7,000	182630,000	9534,116
8,000	180295,500	9534,116
9,000	210720,000	9534,116
10,000	184187,500	9534,116

11,000	193376,000	9534,116
12,000	197856,500	9534,116

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	162572,583	2	41,768	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 08:59:38

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: BX

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,414)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	45588,167	45588,167	93,999	<0,001
Sample	11	4396,833	399,712	0,824	0,623
Residual	11	5334,833	484,985		
Total	23	55319,833	2405,210		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,623).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Tap water	170,500
Gelsemium	83,333

Std Err of LS Mean = 6,357

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	124,000	15,572
2,000	138,500	15,572
3,000	144,500	15,572
4,000	137,500	15,572
5,000	108,000	15,572
6,000	134,000	15,572
7,000	110,500	15,572
8,000	138,000	15,572
9,000	137,500	15,572
10,000	133,500	15,572
11,000	109,000	15,572
12,000	108,000	15,572

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	Diff of Means	p	q	P	P<0,050
Tap water vs. Gelsemium	87,167		213,711	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:00:16

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: YX

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,274)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	155687,042	155687,042	220,167	<0,001
Sample	11	3303,125	300,284	0,425	0,914
Residual	11	7778,458	707,133		
Total	23	166768,625	7250,810		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,914).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	Mean
Tap water	244,417
Gelsemium	83,333

Std Err of LS Mean = 7,676

Least square means for Sample :

Group	Mean	SEM
1,000	160,500	18,803
2,000	165,500	18,803
3,000	179,000	18,803
4,000	175,500	18,803
5,000	145,500	18,803
6,000	164,500	18,803
7,000	147,000	18,803
8,000	171,500	18,803
9,000	176,000	18,803
10,000	177,000	18,803
11,000	153,500	18,803
12,000	151,000	18,803

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	Diff of Means	p	q	P	P<0,050
Tap water vs. Gelsemium	161,083		220,984	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:01:09

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Width**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,452)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	11881,500	11881,500	1603,638	<0,001
Sample	11	270,333	24,576	3,317	0,029
Residual	11	81,500	7,409		
Total	23	12233,333	531,884		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is greater than would be expected by chance after allowing for effects of differences in Product. There is a statistically significant difference (P = 0,029). To isolate which group(s) differ from the others use a multiple comparison procedure.

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,643

Least square means for Product :

Group	**Mean**
Tap water	81,083
Gelsemium	36,583

Std Err of LS Mean = 0,786

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	60,500	1,925
2,000	59,500	1,925
3,000	55,000	1,925
4,000	64,000	1,925
5,000	63,000	1,925
6,000	60,500	1,925
7,000	55,500	1,925
8,000	57,500	1,925
9,000	63,000	1,925
10,000	58,000	1,925
11,000	53,000	1,925
12,000	56,500	1,925

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	44,500	2	56,633	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:01:59

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Height**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,401)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	20300,167	20300,167	540,901	<0,001
Sample	11	482,333	43,848	1,168	0,400
Residual	11	412,833	37,530		
Total	23	21195,333	921,536		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,400).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0794

Least square means for Product :

Group	**Mean**
Tap water	94,750
Gelsemium	36,583

Std Err of LS Mean = 1,768

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	69,000	4,332
2,000	73,000	4,332
3,000	61,500	4,332
4,000	67,000	4,332
5,000	68,000	4,332
6,000	65,000	4,332
7,000	59,000	4,332
8,000	60,500	4,332
9,000	71,000	4,332
10,000	59,000	4,332
11,000	68,000	4,332
12,000	67,000	4,332

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	58,167	2	32,891	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:02:30

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Major**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,292)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	120225259063,37520225259063,375			571,715	<0,001
Sample	11463567949,12542142540,830			1,191	0,388
Residual	11389140864,12535376442,193				
Total	2321077967876,625916433385,940				

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,388).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0839

Least square means for Product :

Group	Mean
Tap water	95286,750
Gelsemium	37227,500

Std Err of LS Mean = 1716,985

Least square means for Sample :

Group	Mean	SEM
1,000	65847,000	4205,737
2,000	68936,500	4205,737
3,000	59603,000	4205,737
4,000	72846,000	4205,737
5,000	65374,000	4205,737
6,000	63237,500	4205,737
7,000	61642,500	4205,737
8,000	61328,500	4205,737
9,000	71648,000	4205,737
10,000	63180,500	4205,737
11,000	69520,500	4205,737
12,000	71921,500	4205,737

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	Diff of Means	p	q	P	P<0,050
Tap water vs. Gelsemium	58059,250		233,815	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:03:03

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Minor**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,371)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	17612100872,0427612100872,042			668,339	<0,001
Sample	11183212994,45816655726,769			1,462	0,270
Residual	11125285373,45811389579,405				
Total	237920599239,958344373879,998				

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,270).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,143

Least square means for Product :

Group	Mean
Tap water	71665,833
Gelsemium	36047,250

Std Err of LS Mean = 974,234

Least square means for Sample :

Group	Mean	SEM
1,000	54022,000	2386,376
2,000	55934,500	2386,376
3,000	54418,000	2386,376
4,000	53612,000	2386,376
5,000	60631,000	2386,376
6,000	53927,000	2386,376
7,000	52723,500	2386,376
8,000	51178,500	2386,376
9,000	56425,000	2386,376
10,000	52653,000	2386,376
11,000	50008,000	2386,376
12,000	50746,000	2386,376

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	Diff of Means	p	q	P	P<0,050
Tap water vs. Gelsemium	35618,583		236,561	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:03:34

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Angle**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,380)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	7657,940	7657,940	6,696	0,025
Sample	11	15865,077	1442,280	1,261	0,354
Residual	11	12580,137	1143,649		
Total	23	36103,154	1569,702		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = 0,025). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,354).

Power of performed test with alpha = 0,0500: for Product : 0,585
Power of performed test with alpha = 0,0500: for Sample : 0,0980

Least square means for Product :

Group	**Mean**
Tap water	73,226
Gelsemium	37,500

Std Err of LS Mean = 9,762

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	50,273	23,913
2,000	94,645	23,913
3,000	97,298	23,913
4,000	26,027	23,913
5,000	43,520	23,913
6,000	39,711	23,913
7,000	31,454	23,913
8,000	23,223	23,913
9,000	76,619	23,913
10,000	67,891	23,913
11,000	80,737	23,913
12,000	32,958	23,913

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	35,726	2	3,660	0,025	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:04:25

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Circ**.

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,338)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	0,0915	0,0915	61,965	<0,001
Sample	11	0,0163	0,00149	1,006	0,496
Residual	11	0,0162	0,00148		
Total	23	0,124	0,00540		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,496).

Power of performed test with alpha = 0,0500: for Product : 1,000

Power of performed test with alpha = 0,0500: for Sample : 0,0509

Least square means for Product :

Group	Mean
Tap water	0,876
Gelsemium	0,999

Std Err of LS Mean = 0,0111

Least square means for Sample :

Group	Mean	
1,000	0,904	
2,000	0,904	
3,000	0,963	
4,000	0,941	
5,000	0,940	
6,000	0,892	
7,000	0,972	
8,000	0,960	
9,000	0,925	
10,000	0,974	
11,000	0,937	
12,000	0,938	Std Err of LS Mean = 0,0272

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Gelsemium vs. Tap water	0,123		211,132	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:04:58

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Feret**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,403)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF SS MS**	**F**	**P**
Product	123034063720,37523034063720,375	670,576	<0,001
Sample	11486670717,45844242792,496	1,288	0,341
Residual	11377846384,12534349671,284		
Total	2323898580821,9581039068731,389		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,341).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,104

Least square means for Product :

Group	Mean
Tap water	99126,417

Gelsemium 37166,667
Std Err of LS Mean = 1691,884

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	69782,000	4144,253
2,000	73122,500	4144,253
3,000	62056,000	4144,253
4,000	73613,500	4144,253
5,000	68093,000	4144,253
6,000	65379,000	4144,253
7,000	64202,000	4144,253
8,000	61186,500	4144,253
9,000	74770,500	4144,253
10,000	64030,000	4144,253
11,000	69588,500	4144,253
12,000	71935,000	4144,253

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	61959,750		236,622	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:05:29

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Median**

Normality Test (Kolmogorov-Smirnov): Failed(P < 0,050)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	6005,778	6005,778	20,335	<0,001
Sample	11	3260,256	296,387	1,004	0,498
Residual	11	3248,706	295,337		
Total	23	12514,740	544,119		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,498).

Power of performed test with alpha = 0,0500: for Product : 0,979
Power of performed test with alpha = 0,0500: for Sample : 0,0506

Least square means for Product :

Group	**Mean**
Tap water	1,779
Gelsemium	33,417

Std Err of LS Mean = 4,961

Least square means for Sample :

Group	**Mean**	**SEM**

1,000	23,413	12,152
2,000	9,336	12,152
3,000	14,862	12,152
4,000	4,886	12,152
5,000	26,889	12,152
6,000	17,863	12,152
7,000	20,886	12,152
8,000	9,457	12,152
9,000	4,862	12,152
10,000	15,897	12,152
11,000	49,422	12,152
12,000	13,395	12,152

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Gelsemium vs. Tap water	31,638	2	6,377	0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:06:29

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Skew**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,500)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	198,444	198,444	207,421	<0,001
Sample	11	8,835	0,803	0,839	0,612
Residual	11	10,524	0,957		
Total	23	217,803	9,470		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,612).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Tap water	6,786
Gelsemium	1,035

Std Err of LS Mean = 0,282

Least square means for Sample :

Group	**Mean**
1,000	3,208
2,000	4,377
3,000	3,949
4,000	3,887
5,000	2,990

6,000	5,125	
7,000	3,565	
8,000	4,209	
9,000	4,743	
10,000	3,316	
11,000	3,565	
12,000	3,990	Std Err of LS Mean = 0,692

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	5,751		220,368	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:07:05

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Kurt**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,272)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	25102,567	25102,567	86,003	<0,001
Sample	11	3298,313	299,847	1,027	0,483
Residual	11	3210,696	291,881		
Total	23	31611,576	1374,416		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,483).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0544

Least square means for Product :

Group	**Mean**
Tap water	66,218
Gelsemium	1,536

Std Err of LS Mean = 4,932

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	19,975	12,081
2,000	35,067	12,081
3,000	46,984	12,081
4,000	26,302	12,081
5,000	22,234	12,081
6,000	56,788	12,081
7,000	22,421	12,081
8,000	37,727	12,081
9,000	48,605	12,081
10,000	22,935	12,081

11,000	40,150	12,081
12,000	27,340	12,081

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	64,682		213,115	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:07:40

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **FeretX**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,319)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	53627,248	53627,248	97,108	<0,001
Sample	11	6599,667	599,970	1,086	0,447
Residual	11	6074,653	552,241		
Total	23	66301,568	2882,677		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,447).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0644

Least square means for Product :

Group	**Mean**
Tap water	185,374
Gelsemium	90,833

Std Err of LS Mean = 6,784

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	141,323	16,617
2,000	155,488	16,617
3,000	163,690	16,617
4,000	139,834	16,617
5,000	116,359	16,617
6,000	141,005	16,617
7,000	116,268	16,617
8,000	146,470	16,617
9,000	156,250	16,617
10,000	146,200	16,617
11,000	121,121	16,617
12,000	113,237	16,617

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	94,540		213,936	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:08:18

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **FeretY**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,166)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1555472877872,667555472877872,667401,501				<0,001
Sample	1115205680834,2501382334621,295			0,999	0,501
Residual	1115218408567,0831383491687,917				
Total	23585896967274,00025473781185,826				

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,501).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : --

Least square means for Product :

Group	**Mean**
Tap water	304377,083
Gelsemium	109,417

Std Err of LS Mean = 10737,363

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	167810,500	26301,062
2,000	115464,000	26301,062
3,000	121611,000	26301,062
4,000	164268,000	26301,062
5,000	119309,000	26301,062
6,000	113838,000	26301,062
7,000	164879,750	26301,062
8,000	163612,750	26301,062
9,000	174617,500	26301,062
10,000	162977,500	26301,062
11,000	179109,500	26301,062
12,000	179421,500	26301,062

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	304267,667		228,337	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:08:57

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **FeretAngle**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,328)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	7310,782	7310,782	5,581	0,038
Sample	11	16132,002	1466,546	1,119	0,427
Residual	11	14410,212	1310,019		
Total	23	37852,997	1645,782		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = 0,038). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,427).

Power of performed test with alpha = 0,0500: for Product : 0,497
Power of performed test with alpha = 0,0500: for Sample : 0,0703

Least square means for Product :

Group	**Mean**
Tap water	72,406
Gelsemium	37,500

Std Err of LS Mean = 10,448

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	43,569	25,593
2,000	96,976	25,593
3,000	99,417	25,593
4,000	22,751	25,593
5,000	49,446	25,593
6,000	49,858	25,593
7,000	25,977	25,593
8,000	27,433	25,593
9,000	74,750	25,593
10,000	66,205	25,593
11,000	73,451	25,593
12,000	29,605	25,593

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	34,906	2	3,341	0,038	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:09:52

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **MinFeret**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,536)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Product	1	8697,434	8697,434	474,125	<0,001
Sample	11	287,856	26,169	1,427	0,283
Residual	11	201,786	18,344		
Total	23	9187,076	399,438		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,283).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,135

Least square means for Product :

Group	**Mean**
Tap water	74,073
Gelsemium	36,000

Std Err of LS Mean = 1,236

Least square means for Sample :

Group	**Mean**	**SEM**
1,000	56,463	3,029
2,000	57,439	3,029
3,000	54,671	3,029
4,000	55,164	3,029
5,000	61,728	3,029
6,000	58,202	3,029
7,000	52,938	3,029
8,000	51,673	3,029
9,000	58,922	3,029
10,000	52,357	3,029
11,000	49,764	3,029
12,000	51,114	3,029

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Tap water vs. Gelsemium	38,073	2	30,794	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:10:32

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **AR**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,332)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	0,554	0,554	39,308	<0,001
Sample	11	0,158	0,0143	1,018	0,489
Residual	11	0,155	0,0141		
Total	23	0,867	0,0377		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,489).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0528

Least square means for Product :

Group	Mean
Tap water	1,337
Gelsemium	1,033

Std Err of LS Mean = 0,0343

Least square means for Sample :

Group	Mean
1,000	1,178
2,000	1,189
3,000	1,078
4,000	1,300
5,000	1,058
6,000	1,133
7,000	1,131
8,000	1,155
9,000	1,213
10,000	1,164
11,000	1,302
12,000	1,314

Std Err of LS Mean = 0,0840

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	Diff of Means	p	q	P	P<0,050
Tap water vs. Gelsemium	0,304	2	8,867	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:11:18

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Round**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,215)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	0,266	0,266	62,153	<0,001
Sample	11	0,0506	0,00460	1,075	0,453
Residual	11	0,0471	0,00428		
Total	23	0,364	0,0158		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = <0,001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,453).

Power of performed test with alpha = 0,0500: for Product : 1,000
Power of performed test with alpha = 0,0500: for Sample : 0,0625

Least square means for Product :

Group	Mean
Tap water	0,758
Gelsemium	0,969

Std Err of LS Mean = 0,0189

Least square means for Sample :

Group	Mean	
1,000	0,857	
2,000	0,851	
3,000	0,929	
4,000	0,795	
5,000	0,948	
6,000	0,891	
7,000	0,892	
8,000	0,882	
9,000	0,844	
10,000	0,866	
11,000	0,804	
12,000	0,807	Std Err of LS Mean = 0,0462

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	Diff of Means	p	q	P	P<0,050
Gelsemium vs. Tap water	0,210	2	11,149	<0,001	Yes

Two Way Analysis of Variancelundi, mai 19, 2025, 09:11:59

Data source: Data 1 in Normalized_FIRE int _BrensTapWater vs Gelsemium_12 values_ANOVA_2w.SNB

General Linear Model (No Interactions)

Dependent Variable: **Solidity**

Normality Test (Kolmogorov-Smirnov): Passed(P = 0,122)

Equal Variance Test (Brown-Forsythe): Passed(P = 1,000)

Source of Variation	DF	SS	MS	F	P
Product	1	0,00215	0,00215	5,310	0,042
Sample	11	0,00520	0,000472	1,169	0,400
Residual	11	0,00445	0,000404		
Total	23	0,0118	0,000513		

The difference in the mean values among the different levels of Product is greater than would be expected by chance after allowing for effects of differences in Sample. There is a statistically significant difference (P = 0,042). To isolate which group(s) differ from the others use a multiple comparison procedure.

The difference in the mean values among the different levels of Sample is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Product. There is not a statistically significant difference (P = 0,400).

Power of performed test with alpha = 0,0500: for Product : 0,474
Power of performed test with alpha = 0,0500: for Sample : 0,0795

Least square means for Product :

Group	**Mean**
Tap water	0,975
Gelsemium	0,994

Std Err of LS Mean = 0,00580

Least square means for Sample :

Group	**Mean**	
1,000	0,957	
2,000	0,970	
3,000	0,991	
4,000	0,989	
5,000	0,993	
6,000	0,953	
7,000	0,999	
8,000	0,991	
9,000	0,990	
10,000	0,994	
11,000	0,991	
12,000	0,994	Std Err of LS Mean = 0,0142

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Product**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0,050**
Gelsemium vs. Tap water	0,0189	2	3,259	0,042	Yes