

# Ácidos orgánicos

## Contents

<b>Acidos orgánicos en peso fresco</b>	<b>1</b>
Acidos orgánicos Totales . . . . .	2
Ácido Tartárico . . . . .	5
Ácido málico . . . . .	7
Ácido quínico . . . . .	9
Ácido succínico . . . . .	12
<b>Acidos orgánicos en peso seco</b>	<b>13</b>
Ácidos orgánicos totales . . . . .	15
Ácido málico . . . . .	19
Ácido quínico . . . . .	21
Ácido succínico . . . . .	24
Relación de ácidos orgánicos y acidez total titulable ATT. . . . .	26
Correlaciones . . . . .	29

## Acidos orgánicos en peso fresco

Concentración del perfil de ácidos orgánicos a distintos estados de Madurez

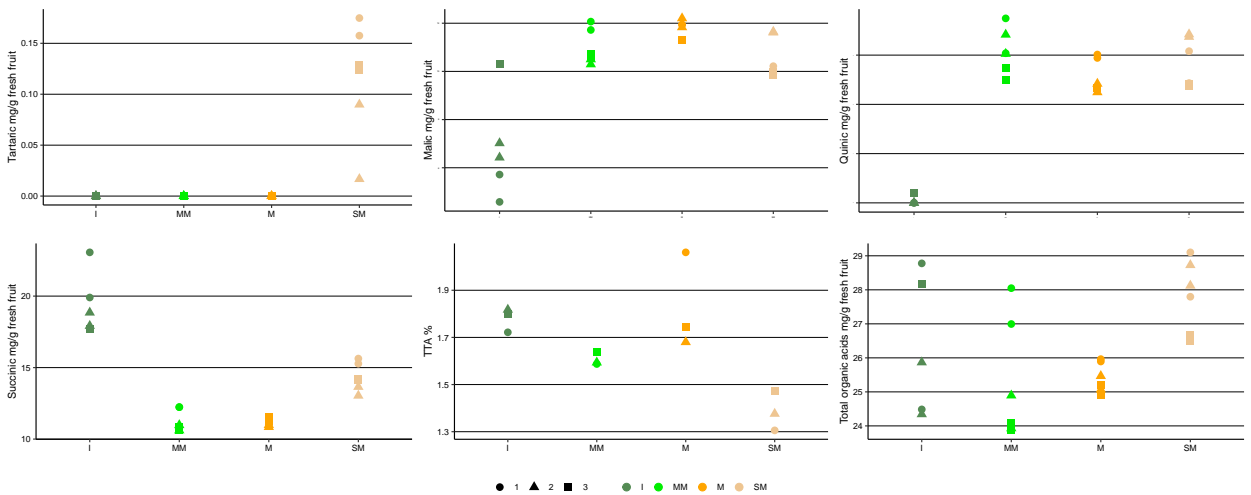


Tabla descriptiva

CAR	MAD	N	CONF	sd	se	ci
Tartárico	I	6	0.0000000	0.0000000	0.0000000	0.0000000
Tartárico	MM	6	0.0000000	0.0000000	0.0000000	0.0000000
Tartárico	M	6	0.0000000	0.0000000	0.0000000	0.0000000
Tartárico	SM	6	0.1152562	0.0564589	0.0230492	0.0592499
Málico	I	6	7.3874887	2.3903972	0.9758756	2.5085680
Málico	MM	6	10.9755462	0.7328273	0.2991755	0.7690551
Málico	M	6	11.7595387	0.3620525	0.1478073	0.3799508
Málico	SM	6	10.5368668	0.8561249	0.3495115	0.8984480
Quínico	I	6	0.0665693	0.1031288	0.0421021	0.1082270
Quínico	MM	6	3.0760242	0.4524811	0.1847246	0.4748497
Quínico	M	6	2.5455362	0.3395038	0.1386018	0.3562873
Quínico	SM	6	2.8491493	0.4983371	0.2034453	0.5229727
Succínico	I	6	19.1837748	2.0849133	0.8511623	2.1879823
Succínico	MM	6	11.2524155	0.7742892	0.3161022	0.8125667
Succínico	M	6	11.1127248	0.2554297	0.1042787	0.2680570
Succínico	SM	6	14.3175103	0.9775555	0.3990853	1.0258815
ATT	I	3	1.7792000	0.0507984	0.0293285	0.1261903
ATT	MM	3	1.6064000	0.0278970	0.0161063	0.0692999
ATT	M	3	1.8282667	0.2039064	0.1177254	0.5065315
ATT	SM	3	1.3845333	0.0835276	0.0482247	0.2074940
TOTALac	I	6	26.6378330	1.9904222	0.8125865	2.0888200
TOTALac	MM	6	25.3039856	1.7882993	0.7300701	1.8767050
TOTALac	M	6	25.4177997	0.4341469	0.1772397	0.4556092
TOTALac	SM	6	27.8187827	1.0618127	0.4334832	1.1143041
NA	I	6	45.6298478	4.8115370	1.9643018	5.0493984
NA	MM	6	36.7682227	5.1410360	2.0988191	5.3951864
NA	M	6	39.1592535	2.5994180	1.0612080	2.7279219
NA	SM	6	53.1196428	1.8422847	0.7521096	1.9333593

Evolución del perfil de ácidos orgánicos

```
## Error in `palette()`:
## ! Insufficient values in manual scale. 6 needed but only 4 provided.
```

## Acidos orgánicos Totales

Concentración de ácidos orgánicos totales

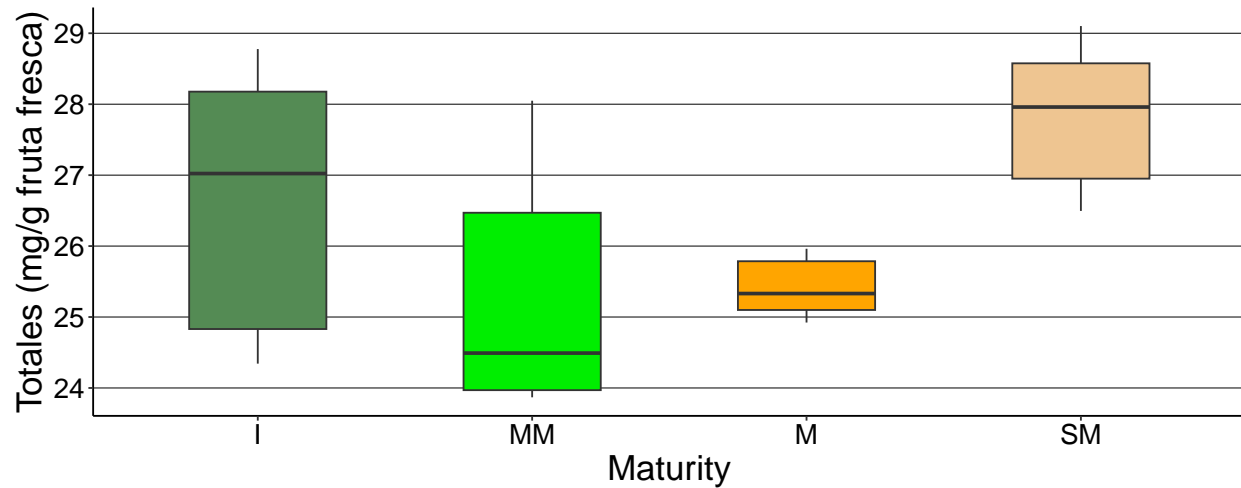
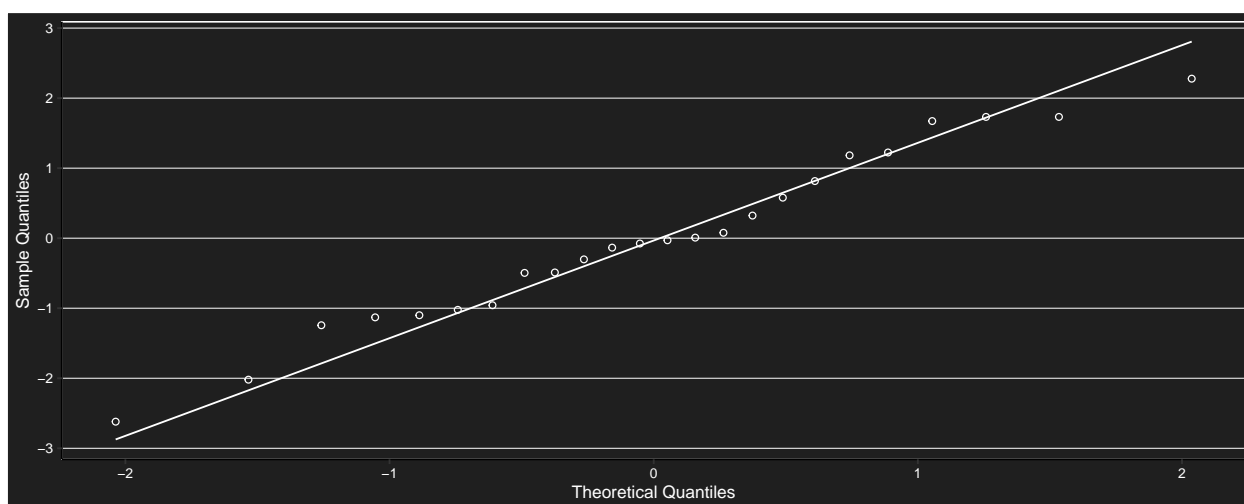
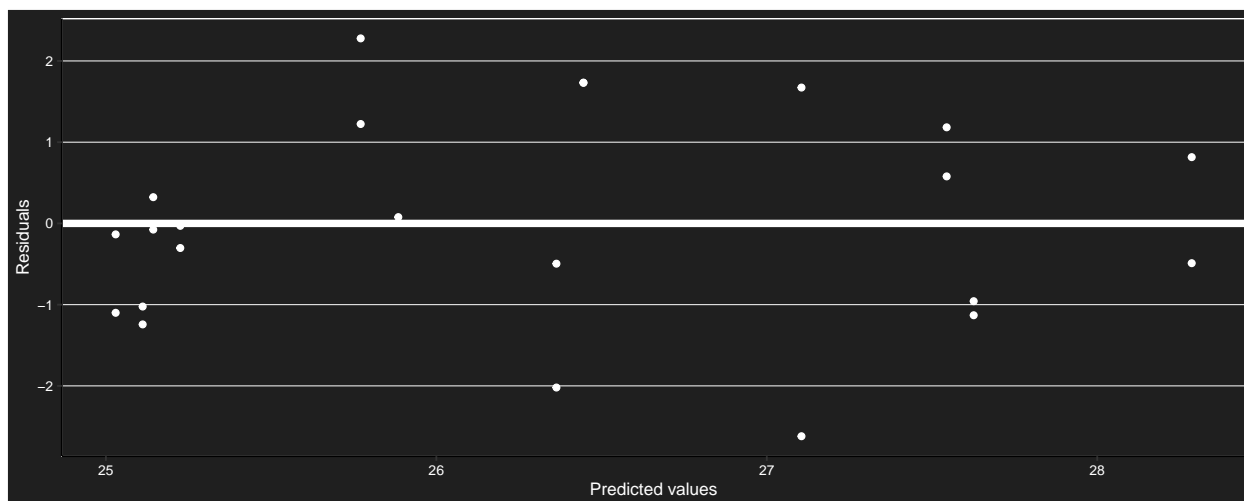


Tabla descriptiva totales

CAR	MAD	N	TOTALF	sd	se	ci
ACIDS	I	6	26.637833	1.9904221	0.8125864	2.0888199
ACIDS	MM	6	25.303985	1.7882992	0.7300701	1.8767049
ACIDS	M	6	25.417800	0.4341472	0.1772399	0.4556096
ACIDS	SM	6	27.818783	1.0618125	0.4334832	1.1143039
CATIONS	I	3	3.590633	1.3255207	0.7652897	3.2927760
CATIONS	MM	3	2.560667	0.3135370	0.1810207	0.7788691
CATIONS	M	3	2.603833	0.3089976	0.1783999	0.7675927
CATIONS	SM	3	2.214367	0.3945083	0.2277695	0.9800130
STAT	I	3	1.721123	0.2633318	0.1520347	0.6541524
STAT	MM	3	1.447652	0.1162909	0.0671406	0.2888827
STAT	M	3	1.541716	0.1326913	0.0766094	0.3296235
STAT	SM	3	1.909504	0.0077334	0.0044649	0.0192107
SUGARS	I	6	45.629848	4.8115374	1.9643019	5.0493989
SUGARS	MM	6	36.768222	5.1410362	2.0988192	5.3951866
SUGARS	M	6	39.159254	2.5994183	1.0612081	2.7279222
SUGARS	SM	6	53.119643	1.8422850	0.7521097	1.9333595

```
## Linear mixed-effects model fit by REML
## Data: dataAT
## Log-restricted-likelihood: -39.09968
## Fixed: TOTALF ~ MAD
## (Intercept)      MADMM      MADM      MADSM
## 26.637833    -1.333847    -1.220033    1.180950
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
## StdDev: 0.5444281 1.371765
##
## Number of Observations: 24
## Number of Groups: 3
```



```
##
##  Shapiro-Wilk normality test
##
## data:  e
## W = 0.97767, p-value = 0.8493
```

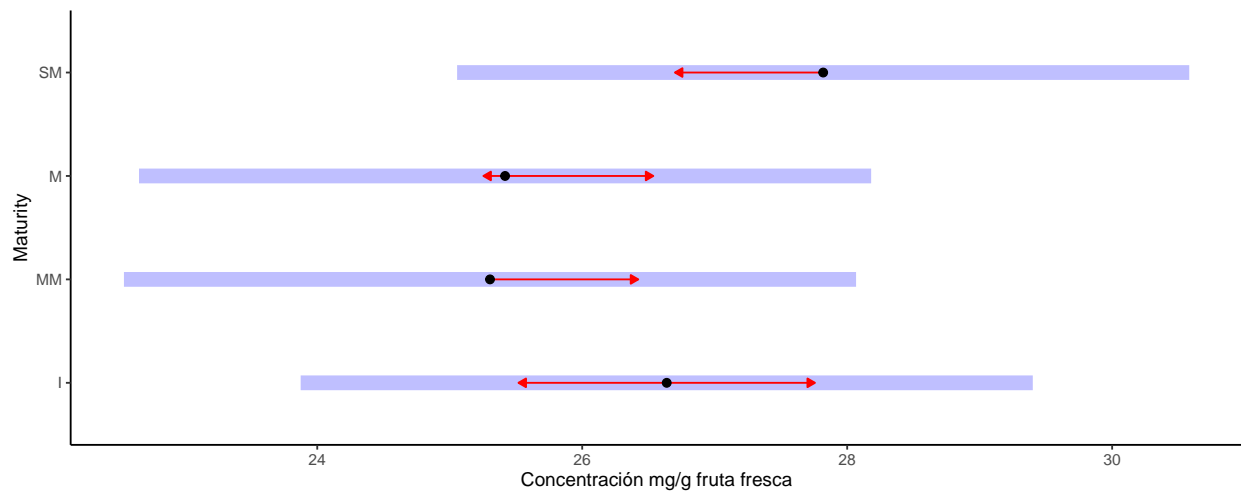
Anova

```
##           numDF denDF  F-value p-value
## (Intercept)      1    18 3901.697  <.0001
## MAD              3    18   4.454  0.0165
```

Test de Tukey

```
## $emmeans
## MAD emmean    SE df lower.CL upper.CL
## I      26.6 0.642  2    23.9    29.4
## MM      25.3 0.642  2    22.5    28.1
```

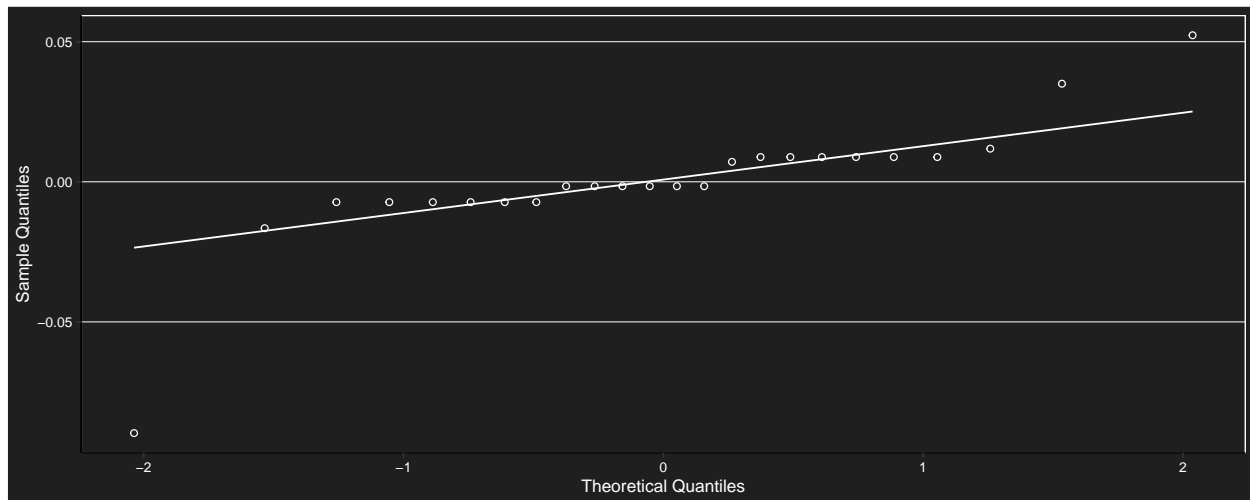
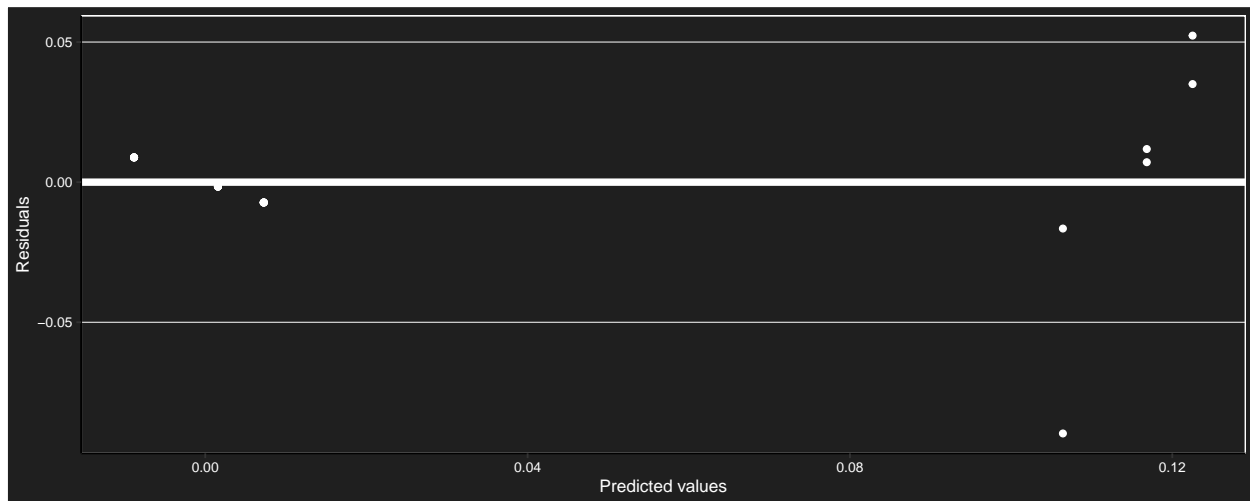
```
## M      25.4 0.642 2      22.7      28.2
## SM     27.8 0.642 2      25.1      30.6
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate      SE df t.ratio p.value
## I - MM      1.334 0.792 18    1.684 0.3602
## I - M       1.220 0.792 18    1.540 0.4354
## I - SM     -1.181 0.792 18   -1.491 0.4629
## MM - M     -0.114 0.792 18   -0.144 0.9989
## MM - SM    -2.515 0.792 18   -3.175 0.0246
## M - SM     -2.401 0.792 18   -3.032 0.0331
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```



## Ácido Tartárico

Modelo y supuestos

```
## Linear mixed-effects model fit by REML
## Data: tar
## Log-restricted-likelihood: 39.7876
## Fixed: CONF ~ MAD
## (Intercept)      MADMM      MADM      MADSM
## -1.163400e-17 -1.916123e-18  1.387779e-17  1.152562e-01
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
## StdDev: 0.01080452 0.0265232
##
## Number of Observations: 24
## Number of Groups: 3
```



```
##
##  Shapiro-Wilk normality test
##
## data:  e
## W = 0.72687, p-value = 2.331e-05
```

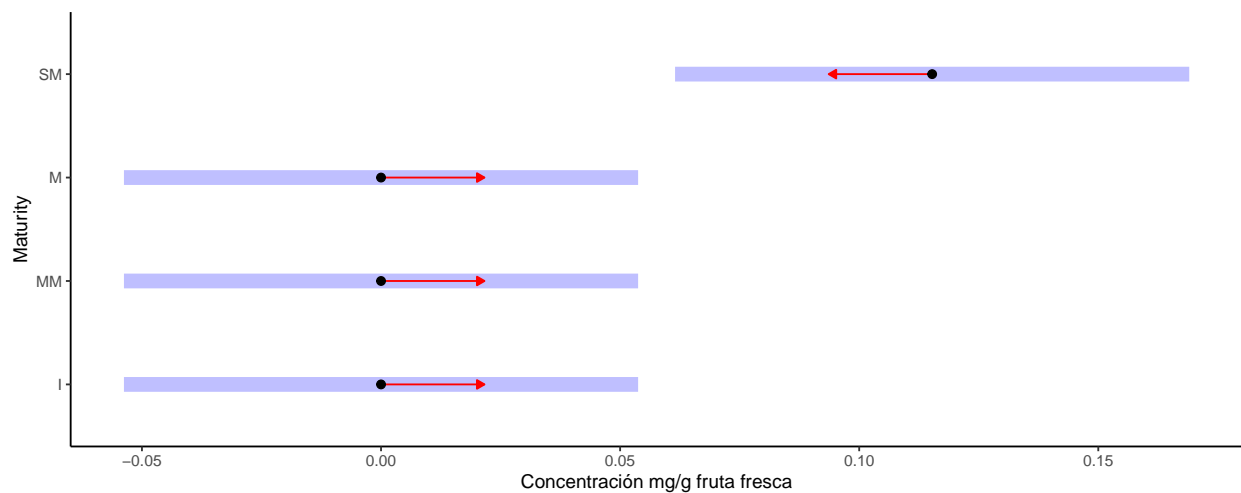
Anova

```
##          numDF denDF  F-value p-value
## (Intercept)    1    18 12.16941  0.0026
## MAD           3    18 28.32485 <.0001
```

Test de Tukey

```
## $emmeans
## MAD emmean      SE df lower.CL upper.CL
## I    0.000 0.0125  2  -0.0538  0.0538
```

```
## MM 0.000 0.0125 2 -0.0538 0.0538
## M 0.000 0.0125 2 -0.0538 0.0538
## SM 0.115 0.0125 2 0.0615 0.1690
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## I - MM 0.000 0.0153 18 0.000 1.0000
## I - M 0.000 0.0153 18 0.000 1.0000
## I - SM -0.115 0.0153 18 -7.527 <.0001
## MM - M 0.000 0.0153 18 0.000 1.0000
## MM - SM -0.115 0.0153 18 -7.527 <.0001
## M - SM -0.115 0.0153 18 -7.527 <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```

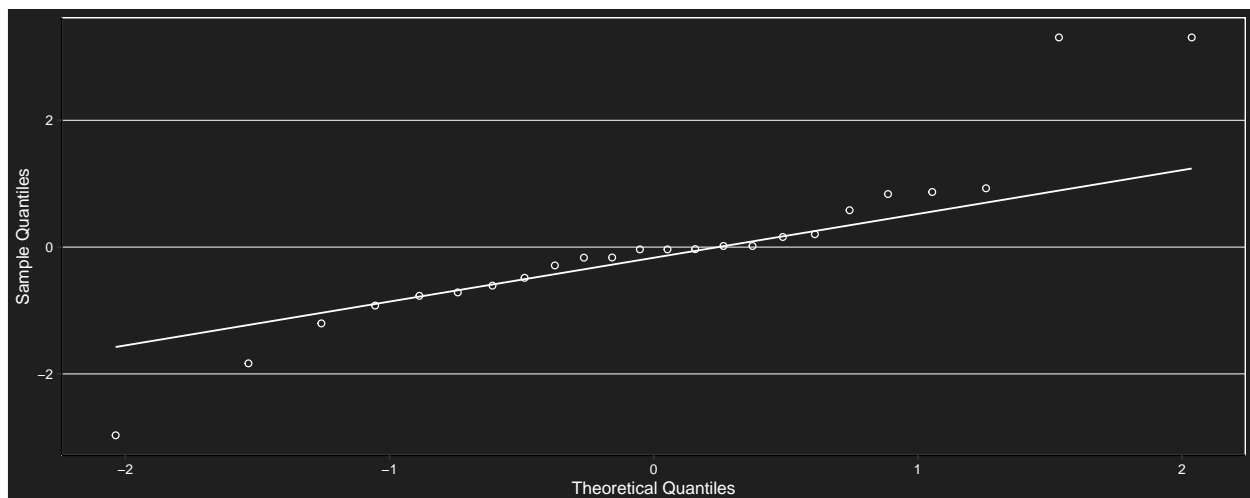
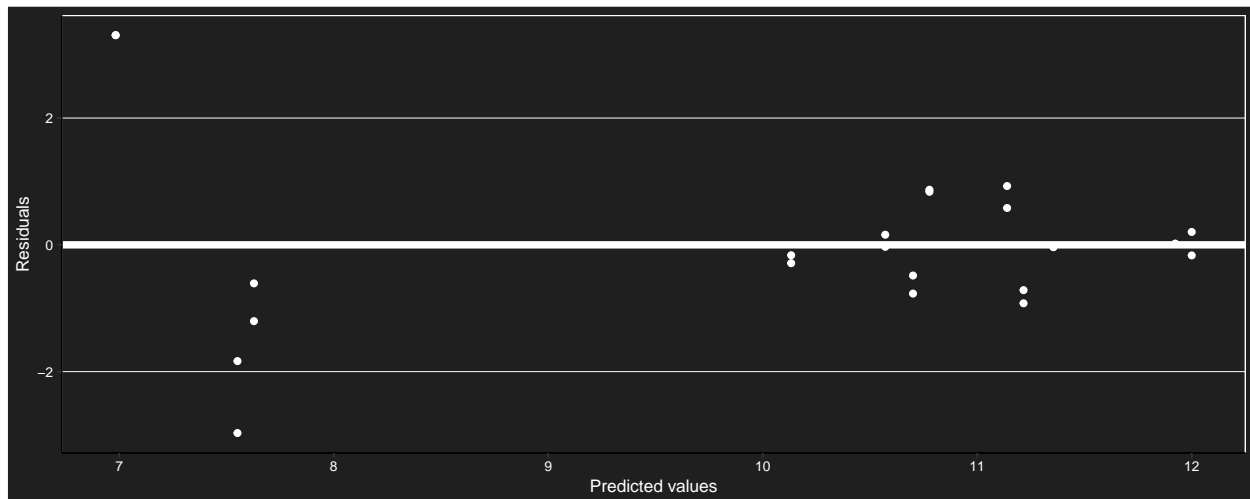


## Ácido málico

Modelo y supuestos

```
## Linear mixed-effects model fit by REML
## Data: mal
## Log-restricted-likelihood: -26.58205
## Fixed: CONF ~ MAD
## (Intercept) MADMM MADM MADSM
## 7.387489 3.588057 4.372050 3.149378
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
## StdDev: 0.3652165 2.680123
##
```

```
## Variance function:
## Structure: Different standard deviations per stratum
## Formula: ~1 | MAD
## Parameter estimates:
##      I      M      MM      SM
## 1.0000000 0.05526687 0.27021057 0.26008009
## Number of Observations: 24
## Number of Groups: 3
```



```
##
## Shapiro-Wilk normality test
##
## data: e
## W = 0.88973, p-value = 0.01312
```

Anova

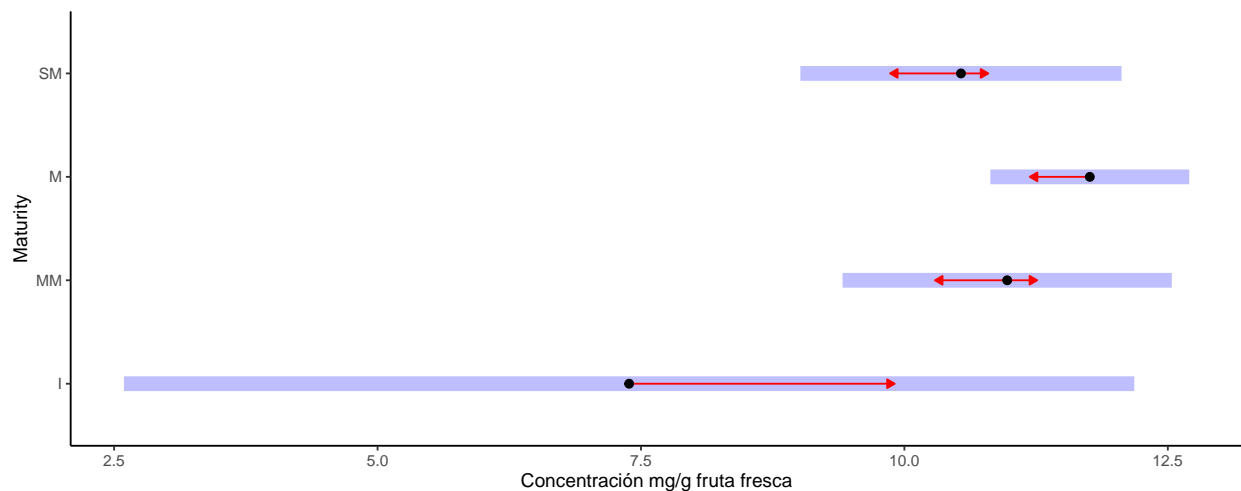
```
##      numDF denDF  F-value p-value
```



```
## (Intercept)      1      18 2846.5229 <.0001
## MAD              3      18  12.9604  1e-04
```

Test de Tukey

```
## $emmeans
## MAD emmean      SE df lower.CL upper.CL
## I      7.39 1.114  2      2.59      12.2
## MM     10.98 0.363  2      9.41      12.5
## M      11.76 0.219  2     10.82      12.7
## SM     10.54 0.354  2      9.01      12.1
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate      SE df t.ratio p.value
## I - MM      -3.588 1.133 18    -3.166  0.0251
## I - M       -4.372 1.096 18    -3.990  0.0043
## I - SM      -3.149 1.131 18    -2.786  0.0542
## MM - M       -0.784 0.302 18    -2.598  0.0780
## MM - SM       0.439 0.410 18     1.069  0.7121
## M - SM       1.223 0.291 18     4.203  0.0027
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```

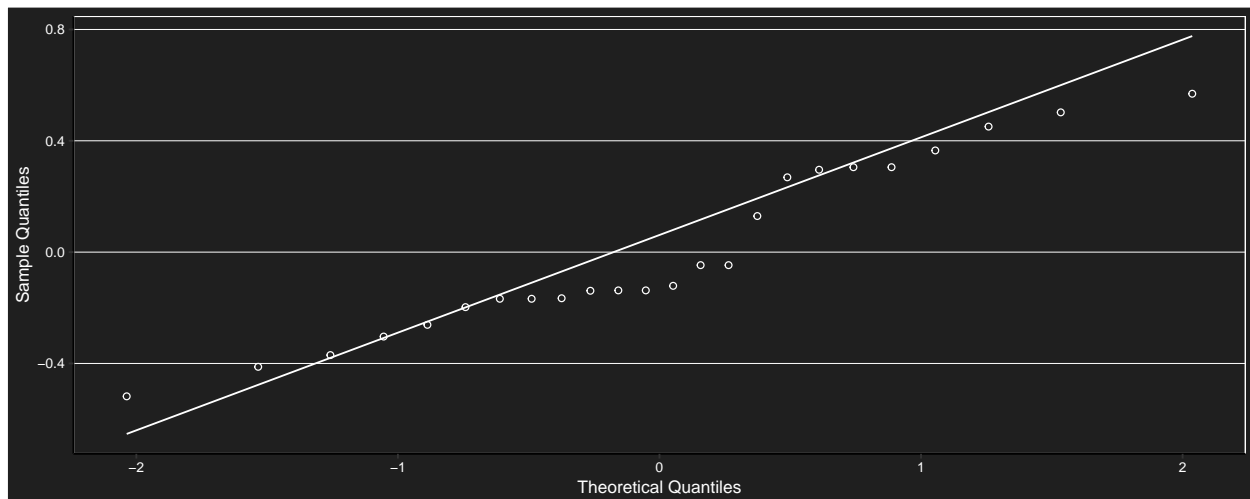
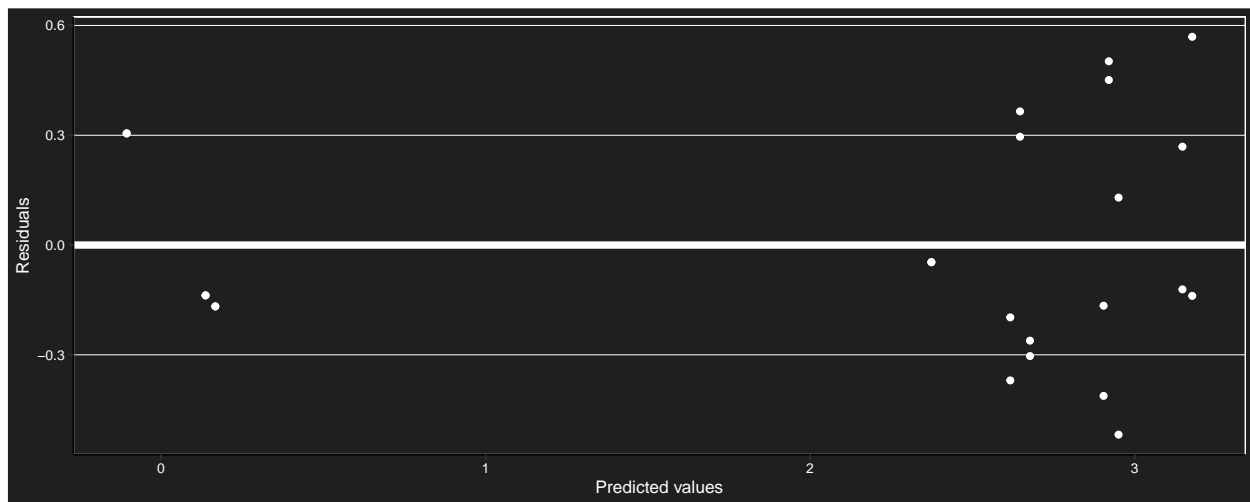


## Ácido quínico

Modelo y supuestos

```
## Linear mixed-effects model fit by REML
## Data: qui
## Log-restricted-likelihood: -11.80976
```

```
## Fixed: CONF ~ MAD
## (Intercept)      MADMM      MADM      MADSM
## 0.06656933 3.00945483 2.47896683 2.78258000
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
## StdDev: 0.1805716 0.3444666
##
## Number of Observations: 24
## Number of Groups: 3
```



```
##
## Shapiro-Wilk normality test
##
## data: e
## W = 0.93241, p-value = 0.1104
```

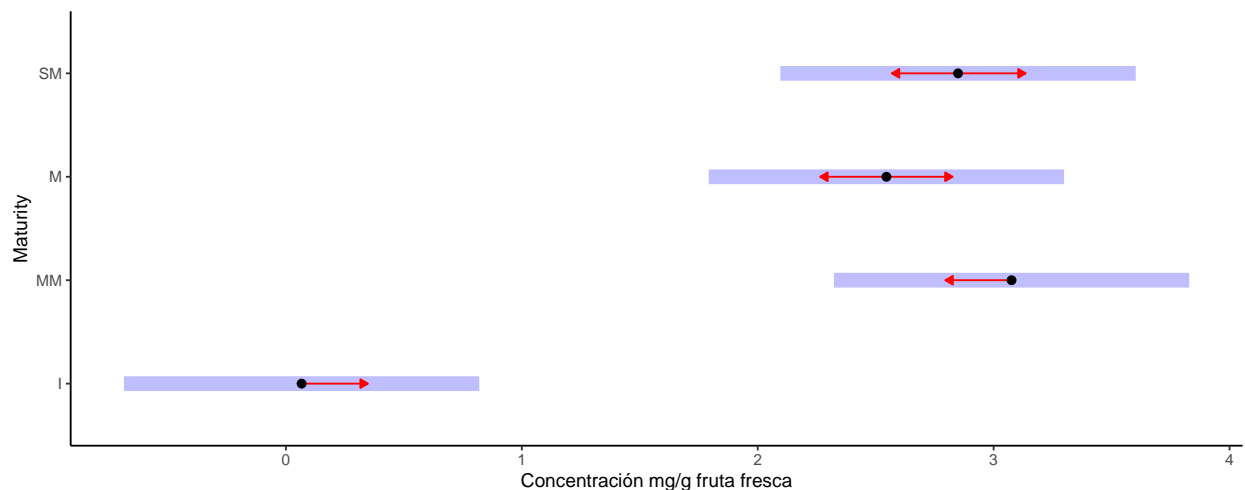
```
## Levene's Test for Homogeneity of Variance (center = median)
##      Df F value Pr(>F)
## group 3  3.0561 0.05203 .
##      20
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Anova

```
##          numDF denDF  F-value p-value
## (Intercept)      1    18 288.07894 <.0001
## MAD              3    18  98.47655 <.0001
```

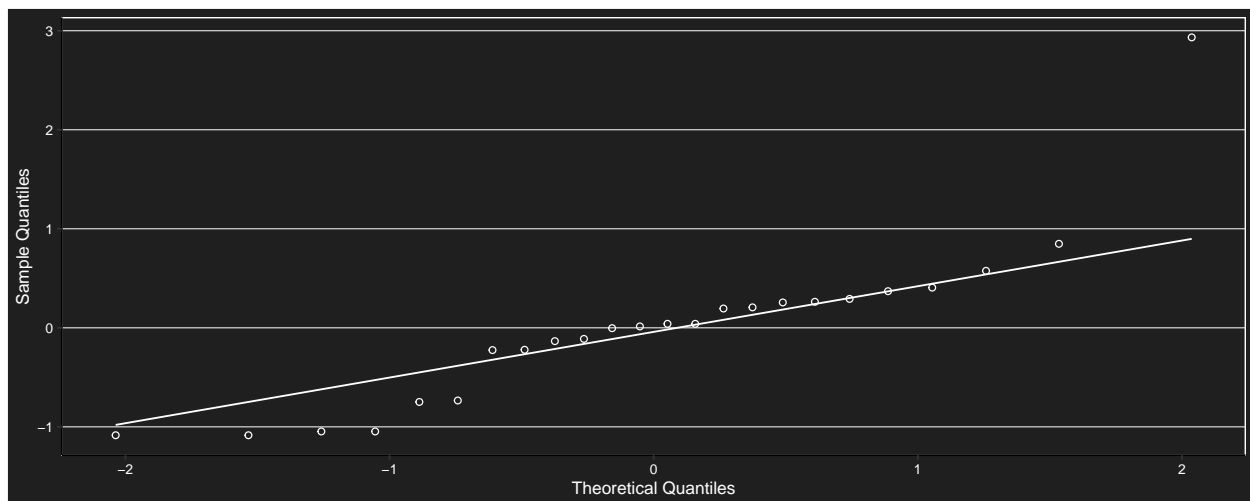
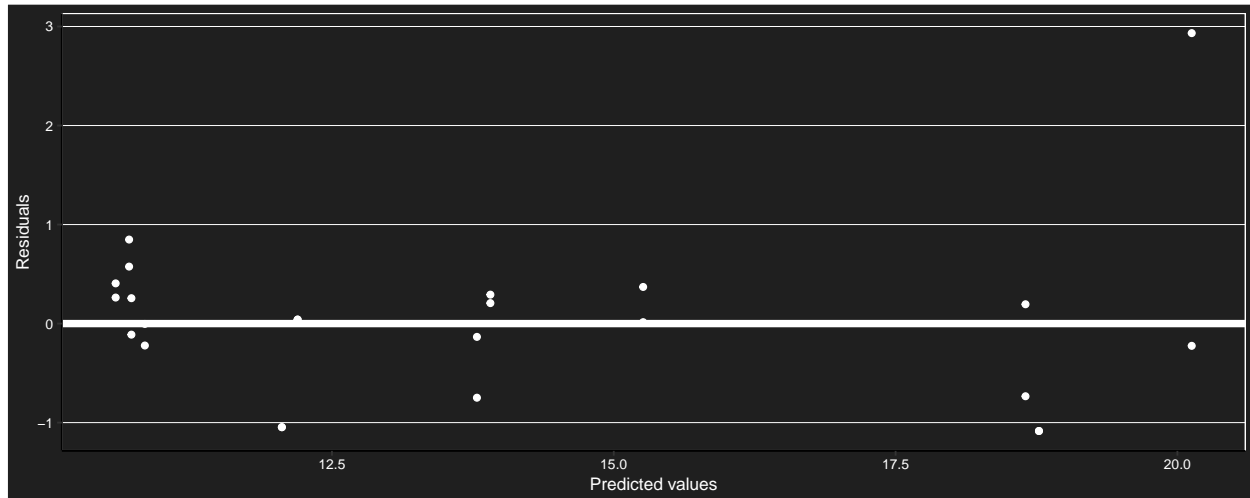
Test de Tukey

```
## $emmeans
## MAD emmean   SE df lower.CL upper.CL
## I   0.0666 0.175  2   -0.687    0.82
## MM  3.0760 0.175  2    2.323    3.83
## M   2.5455 0.175  2    1.792    3.30
## SM  2.8491 0.175  2    2.096    3.60
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate   SE df t.ratio p.value
## I - MM      -3.009 0.199 18 -15.132 <.0001
## I - M        -2.479 0.199 18 -12.465 <.0001
## I - SM       -2.783 0.199 18 -13.991 <.0001
## MM - M        0.530 0.199 18   2.667 0.0683
## MM - SM       0.227 0.199 18   1.141 0.6700
## M - SM       -0.304 0.199 18  -1.527 0.4431
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```



# Ácido succínico

Modelo y supuestos



```
##
##  Shapiro-Wilk normality test
##
## data:  e
## W = 0.8254, p-value = 0.0007898

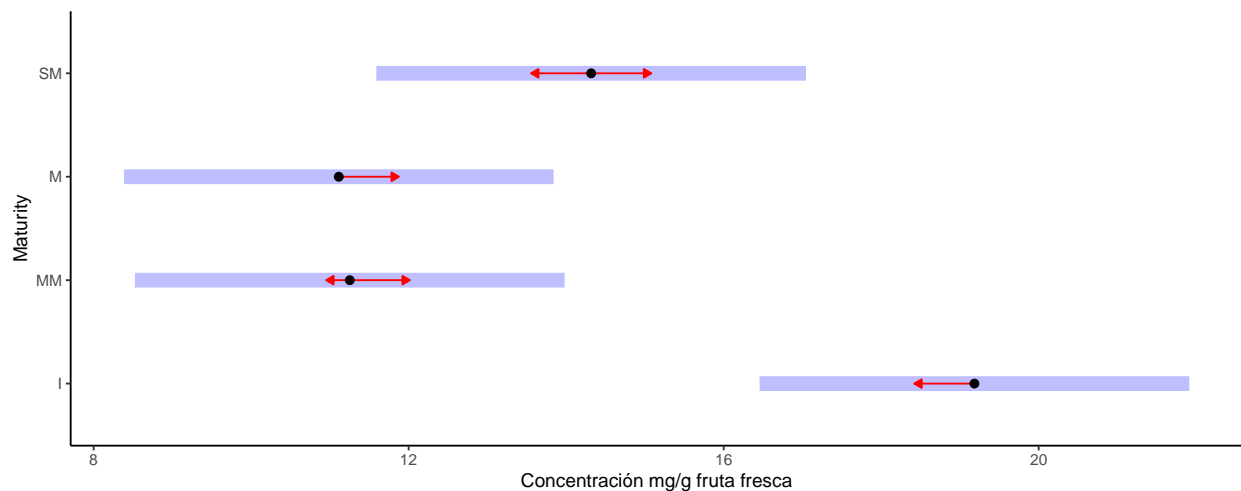
## Levene's Test for Homogeneity of Variance (center = median)
##      Df F value Pr(>F)
## group 3  1.8901 0.1638
##      20
```

Anova

```
##          numDF denDF  F-value p-value
## (Intercept)      1    18 667.5826 <.0001
## MAD              3    18 97.5744  <.0001
```

Test de Tukey

```
## $emmeans
## MAD emmean    SE df lower.CL upper.CL
## I      19.2 0.634  2    16.46    21.9
## MM     11.3 0.634  2     8.52    14.0
## M      11.1 0.634  2     8.38    13.8
## SM     14.3 0.634  2    11.59    17.0
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate    SE df t.ratio p.value
## I - MM       7.93 0.541 18   14.658 <.0001
## I - M        8.07 0.541 18   14.916 <.0001
## I - SM       4.87 0.541 18    8.993 <.0001
## MM - M       0.14 0.541 18    0.258 0.9938
## MM - SM     -3.07 0.541 18   -5.665 0.0001
## M - SM      -3.20 0.541 18   -5.923 0.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```



## Acidos orgánicos en peso seco

Concentración del perfil de ácidos orgánicos

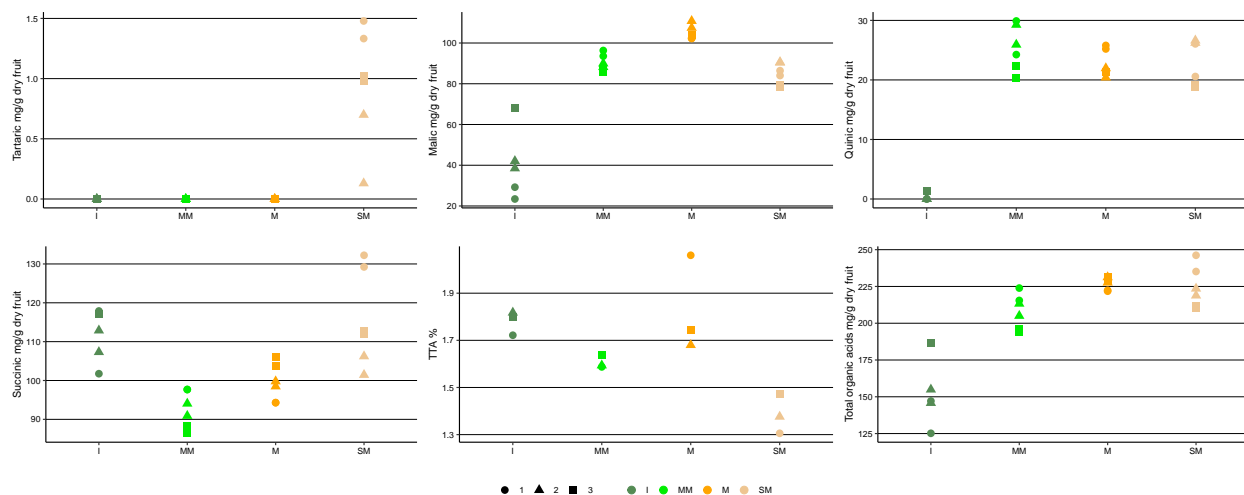


Tabla descriptiva

##	CAR	MAD	N	CONS	sd	se	ci
## 1	Tartárico	I	6	0.0000000	0.00000000	0.00000000	0.00000000
## 2	Tartárico	MM	6	0.0000000	0.00000000	0.00000000	0.00000000
## 3	Tartárico	M	6	0.0000000	0.00000000	0.00000000	0.00000000
## 4	Tartárico	SM	6	0.9411357	0.48306748	0.19721147	0.50694823
## 5	Málico	I	6	44.9021340	19.15238481	7.81892835	20.09919520
## 6	Málico	MM	6	90.1895317	4.02201511	1.64198079	4.22084600
## 7	Málico	M	6	105.1474897	3.36357515	1.37317381	3.52985564
## 8	Málico	SM	6	84.7945992	5.36803324	2.19149040	5.63340540
## 9	Quínico	I	6	0.4406633	0.68267270	0.27869996	0.71642106
## 10	Quínico	MM	6	25.3176063	3.81400139	1.55705955	4.00254899
## 11	Quínico	M	6	22.6888082	2.24262162	0.91554644	2.35348706
## 12	Quínico	SM	6	22.9204245	3.75680532	1.53370935	3.94252539
## 13	Succínico	I	6	112.3334865	6.53452657	2.66770930	6.85756508
## 14	Succínico	MM	6	92.4815923	4.78050904	1.95163464	5.01683657
## 15	Succínico	M	6	99.4372398	4.82401388	1.96939542	5.06249209
## 16	Succínico	SM	6	115.6551513	12.41879308	5.06995105	13.03272407
## 17	ATT	I	3	1.7792000	0.05079843	0.02932848	0.12619028
## 18	ATT	MM	3	1.6064000	0.02789695	0.01610631	0.06929987
## 19	ATT	M	3	1.8282667	0.20390638	0.11772541	0.50653154
## 20	ATT	SM	3	1.3845333	0.08352756	0.04822466	0.20749396
## 21	TOTALac	I	6	157.6762838	24.41479565	9.96729859	25.62175670
## 22	TOTALac	MM	6	207.9887303	11.65695743	4.75893294	12.23322658
## 23	TOTALac	M	6	227.2735377	4.28462553	1.74919105	4.49643873
## 24	TOTALac	SM	6	224.3113107	13.98740598	5.71033458	14.67888234
## 25	<NA>	I	6	266.8807917	8.48194315	3.46273879	8.90125343
## 26	<NA>	MM	6	301.6803547	34.61672247	14.13221777	36.32802229
## 27	<NA>	M	6	350.6257562	31.18238676	12.73015609	32.72390800
## 28	<NA>	SM	6	428.3680832	26.75277911	10.92177634	28.07531986

Evolución del perfil de ácidos orgánicos

```
## Error in `palette()`:
## ! Insufficient values in manual scale. 6 needed but only 4 provided.
```

## Ácidos orgánicos totales

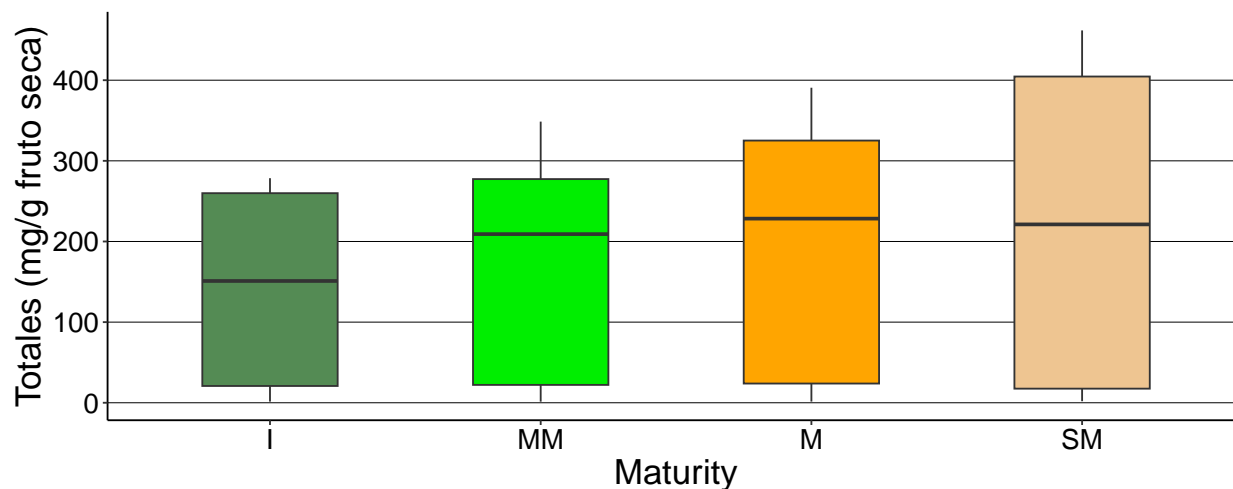


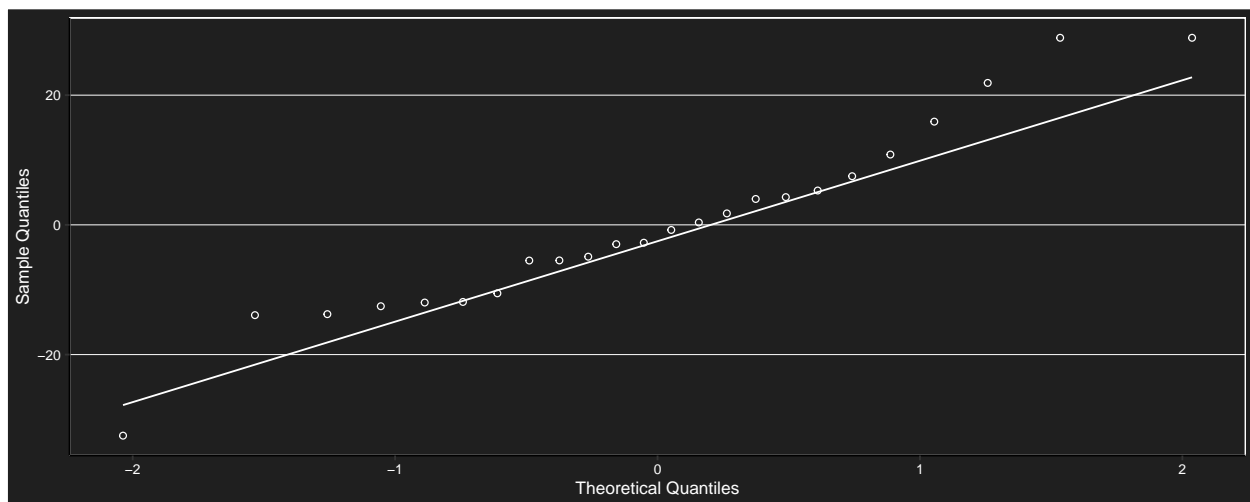
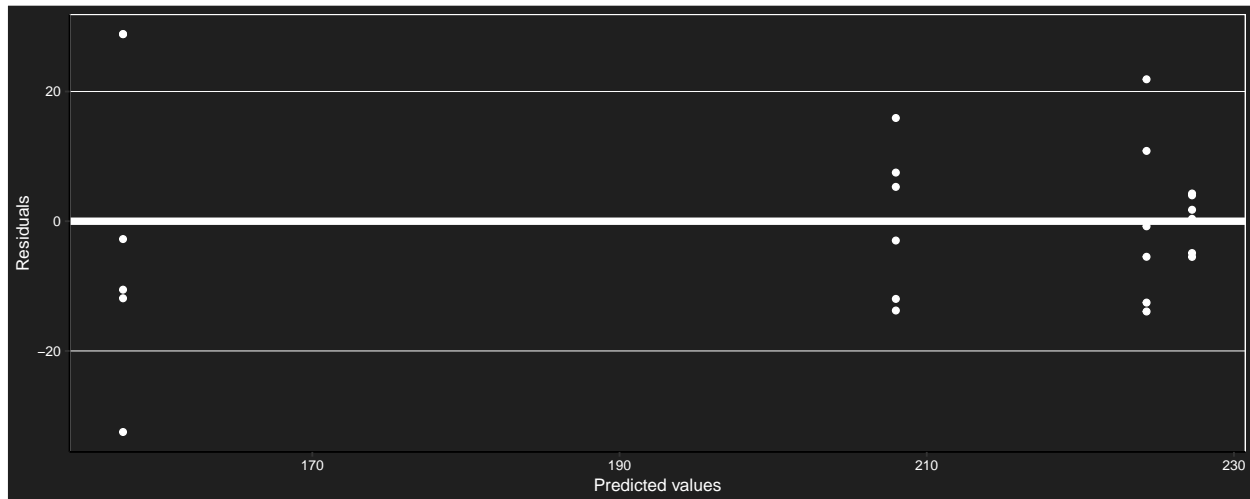
Tabla descriptiva totales

##	CAR	MAD	N	TOTALS	sd	se	ci
## 1	ACIDS	I	6	157.676284	24.414795650	9.967298586	25.62175670
## 2	ACIDS	MM	6	207.988730	11.656957335	4.758932904	12.23322648
## 3	ACIDS	M	6	227.273538	4.284625610	1.749191081	4.49643882
## 4	ACIDS	SM	6	224.311311	13.987405810	5.710334510	14.67888217
## 5	CATIONS	I	3	20.971755	7.741948182	4.469815867	19.23206544
## 6	CATIONS	MM	3	21.053410	2.577853260	1.488324274	6.40374250
## 7	CATIONS	M	3	23.270464	2.761512785	1.594360150	6.85997805
## 8	CATIONS	SM	3	17.826367	3.175919852	1.833618181	7.88942227
## 9	STAT	I	3	1.721122	0.263331773	0.152034670	0.65415239
## 10	STAT	MM	3	1.447652	0.116290919	0.067140593	0.28888266
## 11	STAT	M	3	1.541716	0.132691300	0.076609358	0.32962346
## 12	STAT	SM	3	1.909504	0.007733369	0.004464862	0.01921075
## 13	SUGARS	I	6	266.880792	8.481943277	3.462738843	8.90125357
## 14	SUGARS	MM	6	301.680355	34.616722145	14.132217637	36.32802196
## 15	SUGARS	M	6	350.625756	31.182386756	12.730156086	32.72390800
## 16	SUGARS	SM	6	428.368083	26.752778568	10.921776116	28.07531930

## Modelo y supuestos

```
## Linear mixed-effects model fit by REML
## Data: dataAT
## Log-restricted-likelihood: -86.62191
## Fixed: TOTALS ~ MAD
## (Intercept)      MADMM      MADM      MADSM
## 157.67628    50.31245    69.59725    66.63503
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
## StdDev: 0.1187511 15.3783
```

```
##
## Number of Observations: 24
## Number of Groups: 3
```



```
##
## Shapiro-Wilk normality test
##
## data: e
## W = 0.95588, p-value = 0.3613
```

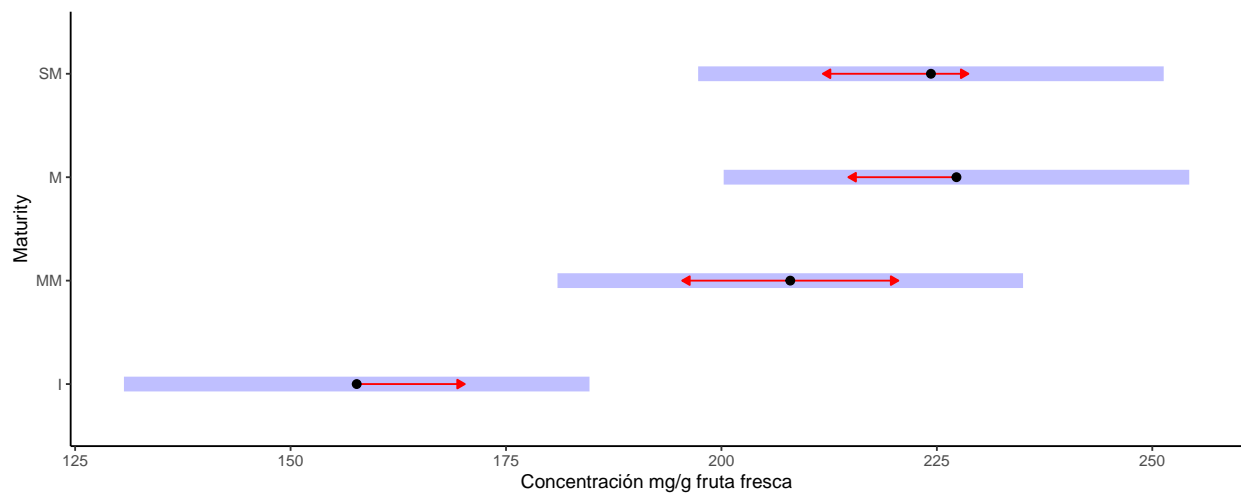
Anova

```
##          numDF denDF  F-value p-value
## (Intercept)    1    18 4234.257 <.0001
## MAD            3    18   26.349 <.0001
```

Test de Tukey



```
## $emmeans
## MAD emmean SE df lower.CL upper.CL
## I      158 6.28 2      131      185
## MM     208 6.28 2      181      235
## M      227 6.28 2      200      254
## SM     224 6.28 2      197      251
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## I - MM     -50.31 8.88 18  -5.667 0.0001
## I - M      -69.60 8.88 18  -7.839 <.0001
## I - SM     -66.64 8.88 18  -7.505 <.0001
## MM - M     -19.28 8.88 18  -2.172 0.1689
## MM - SM    -16.32 8.88 18  -1.838 0.2886
## M - SM       2.96 8.88 18   0.334 0.9868
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```

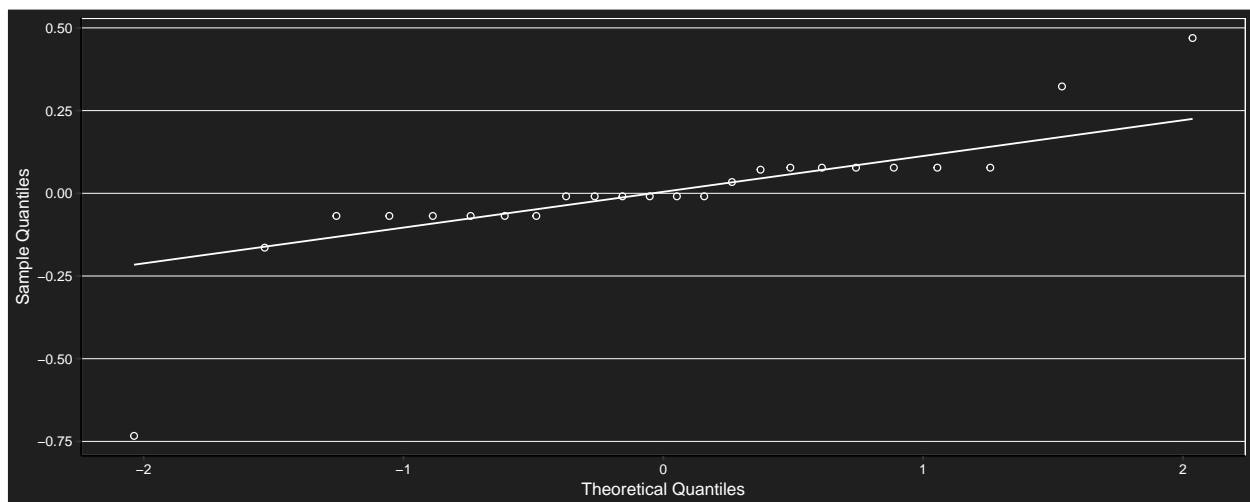
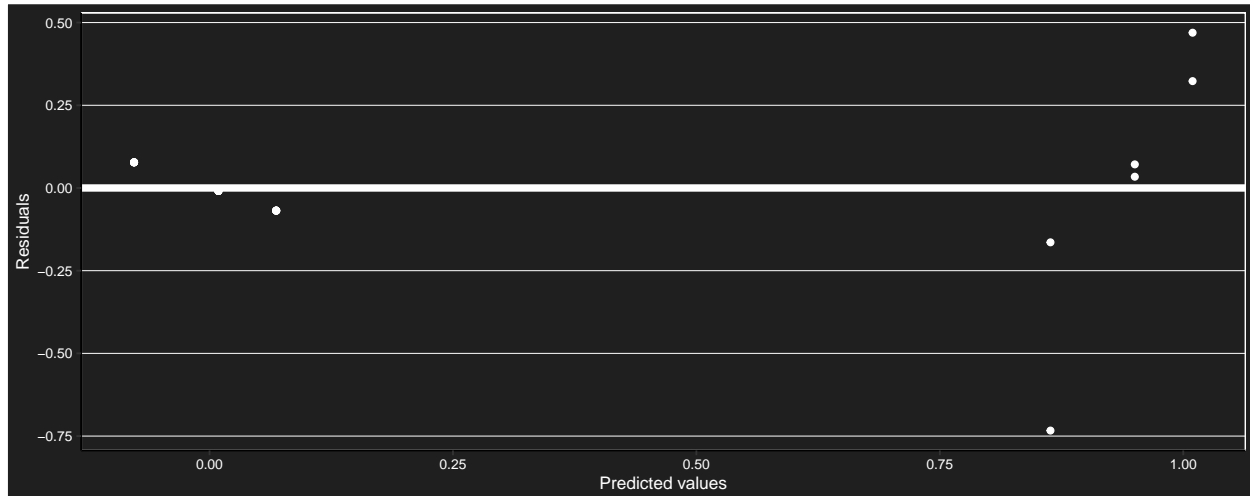


Ácido tartárico

Modelo y supuestos

```
## Linear mixed-effects model fit by REML
## Data: tar
## Log-restricted-likelihood: -3.096888
## Fixed: CONS ~ MAD
## (Intercept) MADMM MADM MADSM
## 8.709897e-17 -1.263513e-16 -2.220446e-16 9.411357e-01
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
```

```
## StdDev:  0.09563016 0.2258815
##
## Number of Observations: 24
## Number of Groups: 3
```



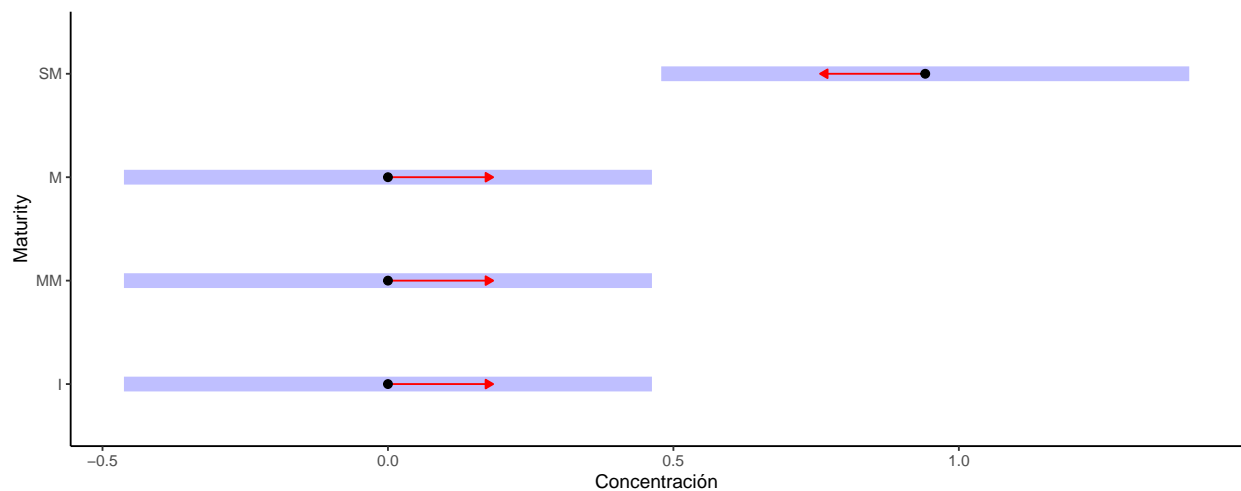
```
##
## Shapiro-Wilk normality test
##
## data:  e
## W = 0.75036, p-value = 5.041e-05
```

Anova

	numDF	denDF	F-value	p-value
(Intercept)	1	18	10.69872	0.0042
MAD	3	18	26.03961	<.0001

Test de Tukey

```
## $emmeans
## MAD emmean    SE df lower.CL upper.CL
## I      0.000 0.107  2   -0.462   0.462
## MM     0.000 0.107  2   -0.462   0.462
## M       0.000 0.107  2   -0.462   0.462
## SM     0.941 0.107  2    0.479   1.404
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate    SE df t.ratio p.value
## I - MM      0.000 0.13 18    0.000 1.0000
## I - M        0.000 0.13 18    0.000 1.0000
## I - SM     -0.941 0.13 18   -7.217 <.0001
## MM - M       0.000 0.13 18    0.000 1.0000
## MM - SM     -0.941 0.13 18   -7.217 <.0001
## M - SM      -0.941 0.13 18   -7.217 <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```

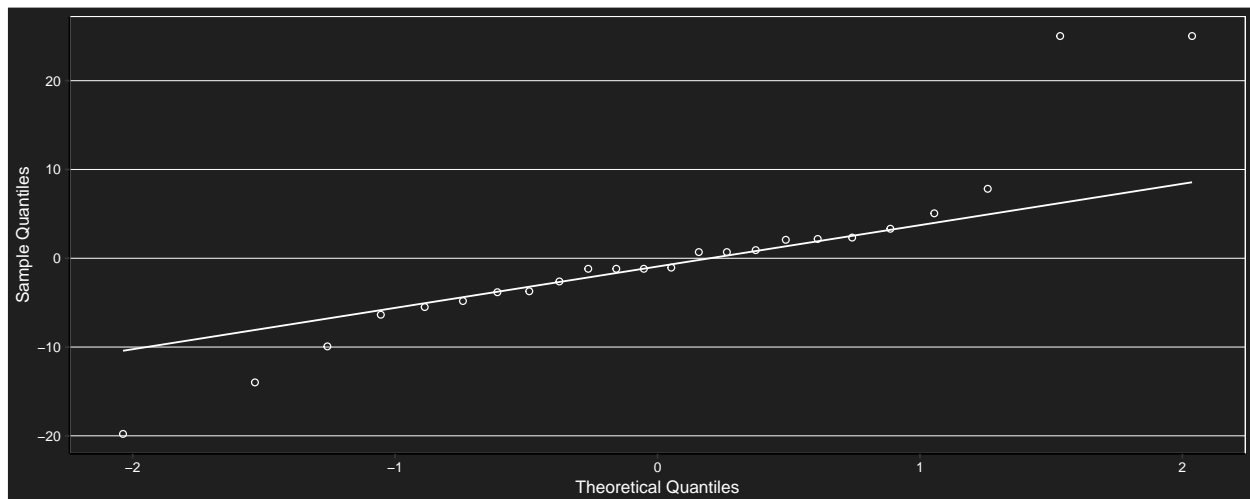
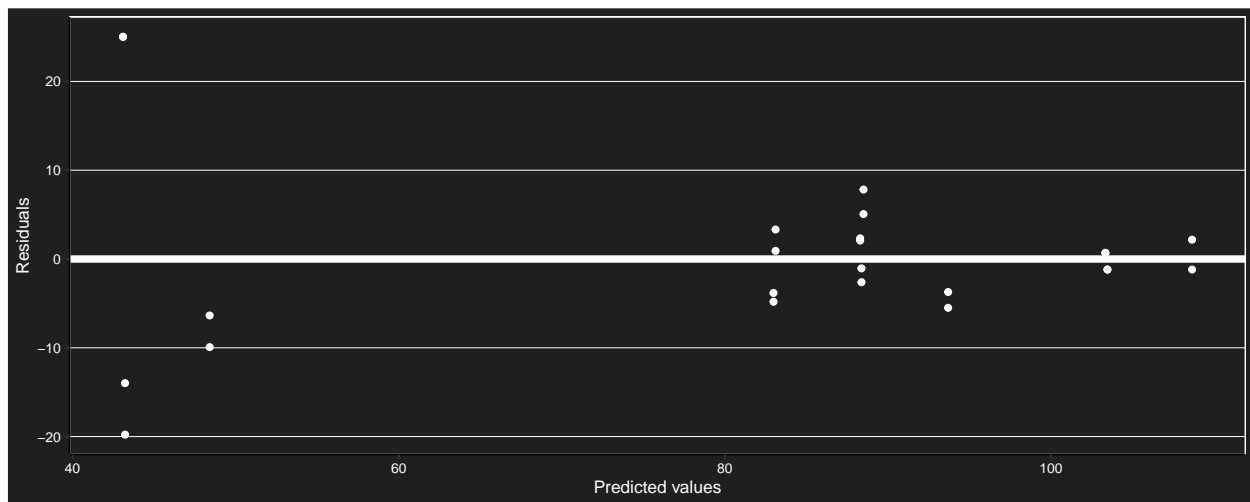


## Ácido málico

Modelo y supuestos

```
## Linear mixed-effects model fit by REML
## Data: mal
## Log-restricted-likelihood: -66.5285
## Fixed: CONS ~ MAD
## (Intercept)    MADMM    MADM    MADSM
## 44.90213    45.28740    60.24536    39.89247
##
## Random effects:
## Formula: ~1 | REP
```

```
##          (Intercept) Residual
## StdDev:    3.184406 19.91438
##
## Variance function:
## Structure: Different standard deviations per stratum
## Formula: ~1 | MAD
## Parameter estimates:
##          I          M          MM          SM
## 1.0000000 0.0829966 0.2681539 0.1785083
## Number of Observations: 24
## Number of Groups: 3
```



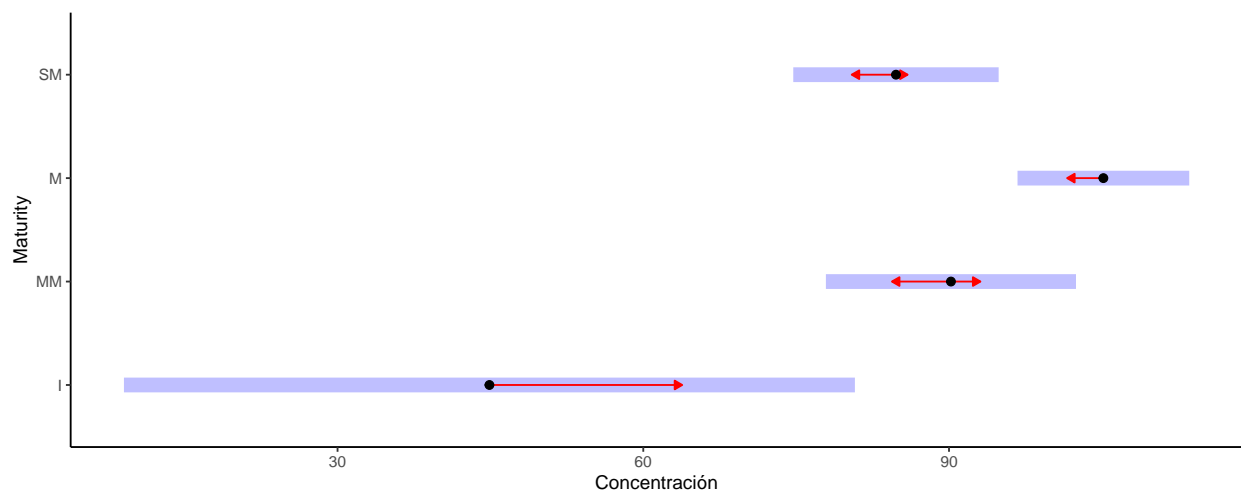
```
##
## Shapiro-Wilk normality test
##
## data: e
## W = 0.87203, p-value = 0.005766
```

Anova

```
##          numDF denDF    F-value p-value
## (Intercept)      1    18 2706.3660 <.0001
## MAD              3    18   77.8867 <.0001
```

Test de Tukey

```
## $emmeans
## MAD emmean    SE df lower.CL upper.CL
## I      44.9 8.34  2     9.04    80.8
## MM     90.2 2.85  2    77.92   102.5
## M     105.1 1.96  2    96.72   113.6
## SM     84.8 2.34  2    74.72    94.9
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate    SE df t.ratio p.value
## I - MM      -45.29 8.42 18   -5.380 0.0002
## I - M       -60.25 8.16 18   -7.385 <.0001
## I - SM      -39.89 8.26 18   -4.830 0.0007
## MM - M       -14.96 2.28 18   -6.554 <.0001
## MM - SM        5.39 2.62 18    2.060 0.2038
## M - SM       20.35 1.60 18   12.717 <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```



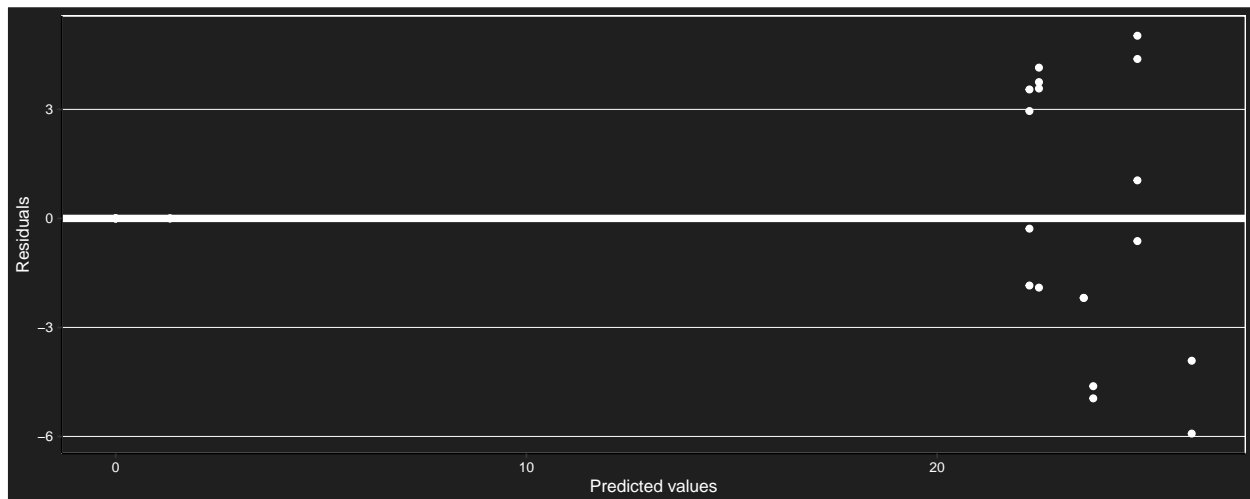
## Ácido quínico

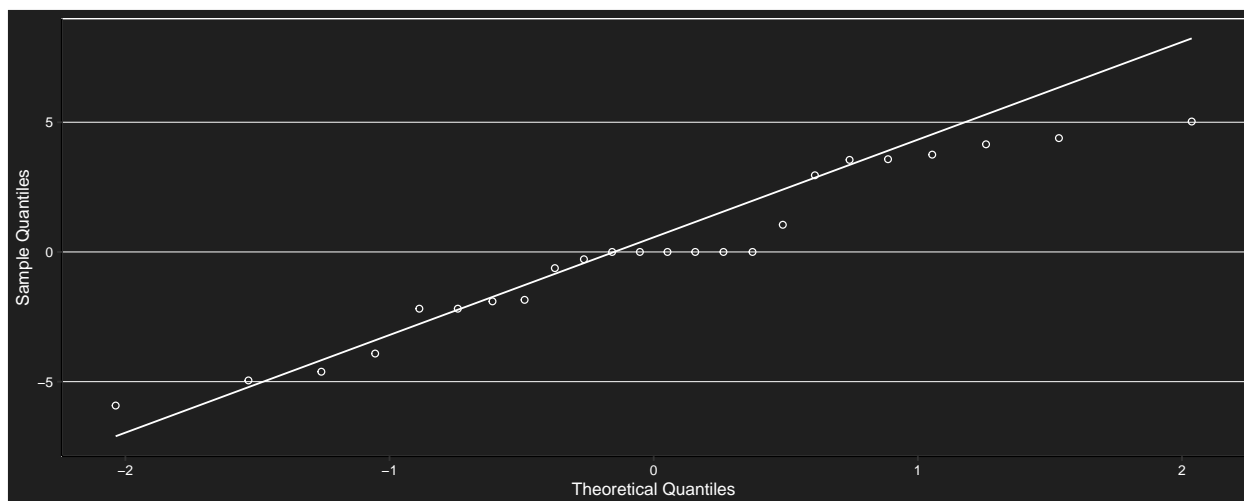
Modelo y supuestos

```

## Linear mixed-effects model fit by REML
##   Data: qui
##   Log-restricted-likelihood: 58.15489
##   Fixed: CONS ~ MAD
## (Intercept)      MADMM      MADM      MADSM
##  0.3746778  24.8769430  22.2481448  22.4797612
##
## Random effects:
## Formula: ~1 | REP
##      (Intercept)      Residual
## StdDev:   0.6710272  1.179409e-16
##
## Variance function:
## Structure: Different standard deviations per stratum
## Formula: ~1 | MAD
## Parameter estimates:
##      I      M      MM      SM
## 1.000000e+00 2.223316e+16 3.723258e+16 3.666682e+16
## Number of Observations: 24
## Number of Groups: 3

```





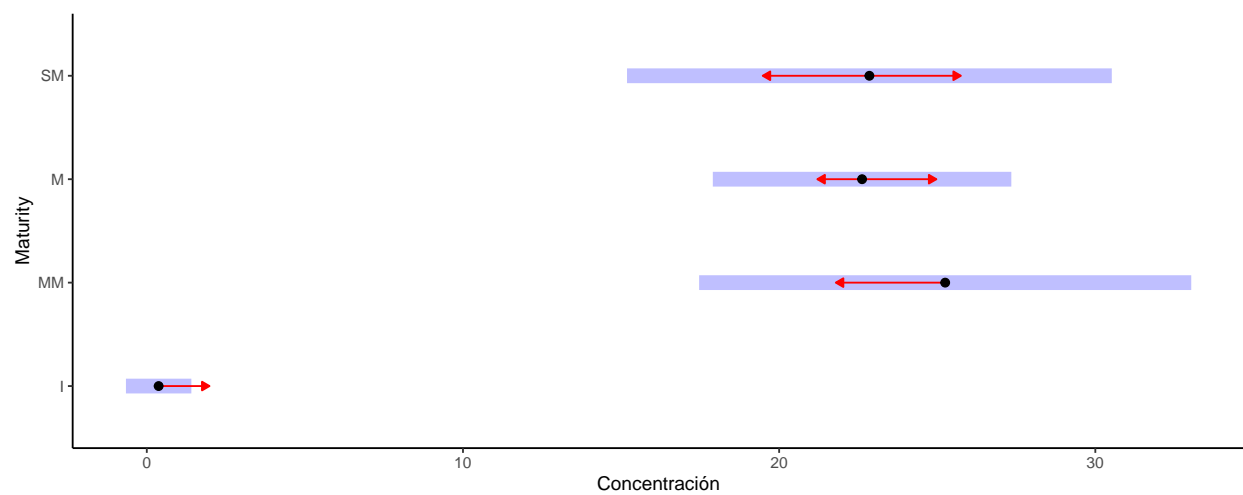
```
##
##  Shapiro-Wilk normality test
##
## data:  e
## W = 0.94578, p-value = 0.2191
```

Anova

```
##           numDF denDF   F-value p-value
## (Intercept)      1    18    2.42807  0.1366
## MAD              3    18  262.20498 <.0001
```

Test de Tukey

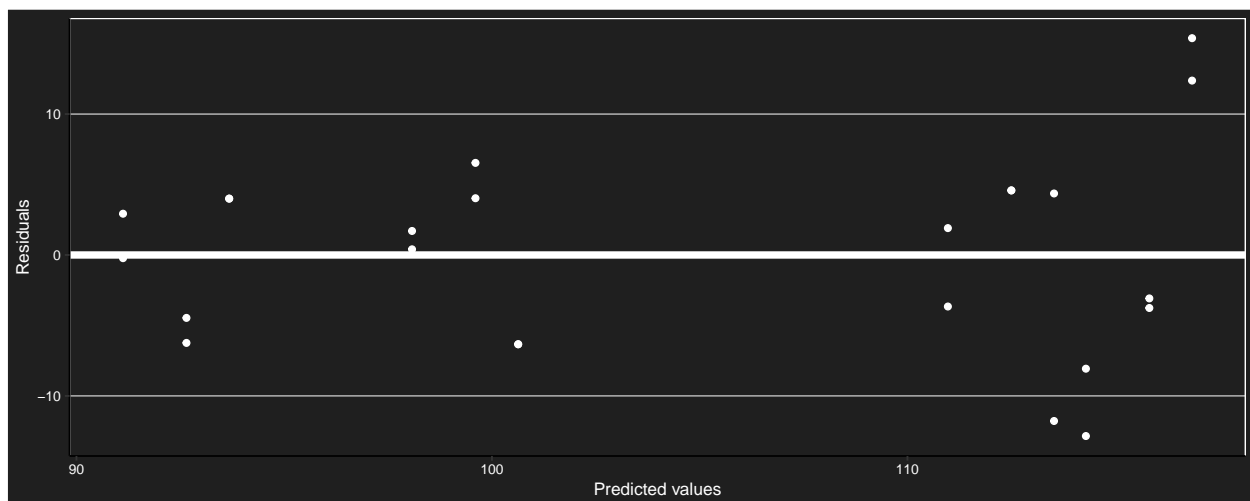
```
## $emmeans
## MAD emmean   SE df lower.CL upper.CL
## I    0.375 0.24  2   -0.66    1.41
## MM  25.252 1.81  2   17.47   33.03
## M   22.623 1.10  2   17.90   27.34
## SM  22.854 1.78  2   15.19   30.52
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate   SE df t.ratio p.value
## I - MM   -24.877 1.79 18  -13.877 <.0001
## I - M    -22.248 1.07 18  -20.783 <.0001
## I - SM   -22.480 1.77 18  -12.733 <.0001
## MM - M     2.629 2.09 18    1.259 0.5992
## MM - SM    2.397 2.52 18    0.953 0.7772
## M - SM    -0.232 2.06 18   -0.112 0.9995
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```



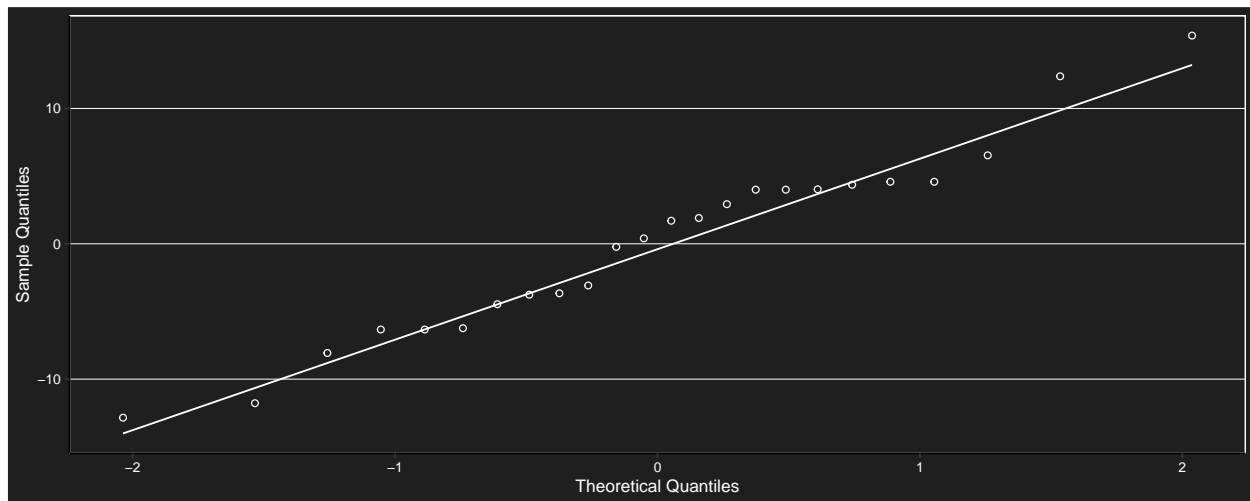
## Ácido succínico

Modelo y supuestos

```
## Linear mixed-effects model fit by REML
## Data: suc
## Log-restricted-likelihood: -72.91629
## Fixed: CONS ~ MAD
## (Intercept)      MADMM      MADM      MADSM
## 112.333486 -19.851894 -12.896247  3.321665
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
## StdDev:    2.089065 7.567785
##
## Number of Observations: 24
## Number of Groups: 3
```







```
##
## Shapiro-Wilk normality test
##
## data: e
## W = 0.96753, p-value = 0.6065

## Levene's Test for Homogeneity of Variance (center = median)
##      Df F value Pr(>F)
## group 3  1.4818 0.2497
##      20
```

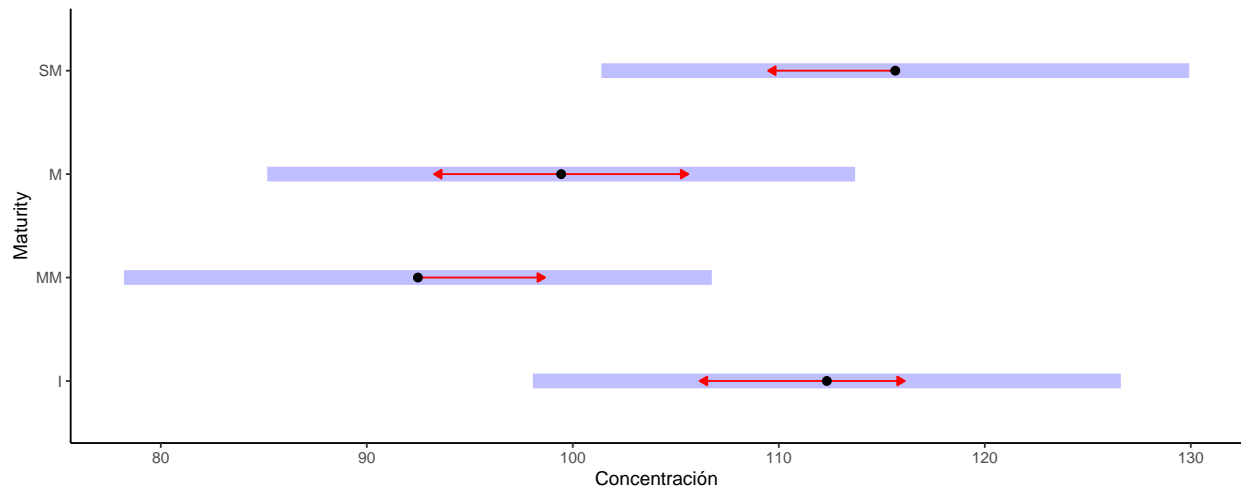
Anova

```
##           numDF denDF   F-value p-value
## (Intercept)      1    18 2869.0535 <.0001
## MAD              3    18  12.3959 1e-04
```

Test de Tukey

```
## $emmeans
## MAD emmean SE df lower.CL upper.CL
## I      112.3 3.32 2      98.1      127
## MM      92.5 3.32 2      78.2      107
## M       99.4 3.32 2      85.2      114
## SM     115.7 3.32 2     101.4      130
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## I - MM      19.85 4.37 18   4.544 0.0013
## I - M       12.90 4.37 18   2.952 0.0389
## I - SM      -3.32 4.37 18  -0.760 0.8711
## MM - M      -6.96 4.37 18  -1.592 0.4076
```

```
## MM - SM      -23.17 4.37 18  -5.304  0.0003
## M - SM       -16.22 4.37 18  -3.712  0.0079
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates
```



### Relación de ácidos orgánicos y acidez total titulable ATT.

##	CAR	MAD	N	CONS	sd	se	ci
## 1	Tartárico	I	6	0.0000000	0.00000000	0.00000000	0.00000000
## 2	Tartárico	MM	6	0.0000000	0.00000000	0.00000000	0.00000000
## 3	Tartárico	M	6	0.0000000	0.00000000	0.00000000	0.00000000
## 4	Tartárico	SM	6	0.9411357	0.48306748	0.19721147	0.50694823
## 5	Málico	I	6	44.9021340	19.15238481	7.81892835	20.09919520
## 6	Málico	MM	6	90.1895317	4.02201511	1.64198079	4.22084600
## 7	Málico	M	6	105.1474897	3.36357515	1.37317381	3.52985564
## 8	Málico	SM	6	84.7945992	5.36803324	2.19149040	5.63340540
## 9	Quínico	I	6	0.4406633	0.68267270	0.27869996	0.71642106
## 10	Quínico	MM	6	25.3176063	3.81400139	1.55705955	4.00254899
## 11	Quínico	M	6	22.6888082	2.24262162	0.91554644	2.35348706
## 12	Quínico	SM	6	22.9204245	3.75680532	1.53370935	3.94252539
## 13	Succínico	I	6	112.3334865	6.53452657	2.66770930	6.85756508
## 14	Succínico	MM	6	92.4815923	4.78050904	1.95163464	5.01683657
## 15	Succínico	M	6	99.4372398	4.82401388	1.96939542	5.06249209
## 16	Succínico	SM	6	115.6551513	12.41879308	5.06995105	13.03272407
## 17	ATT	I	3	1.7792000	0.05079843	0.02932848	0.12619028
## 18	ATT	MM	3	1.6064000	0.02789695	0.01610631	0.06929987
## 19	ATT	M	3	1.8282667	0.20390638	0.11772541	0.50653154
## 20	ATT	SM	3	1.3845333	0.08352756	0.04822466	0.20749396
## 21	TOTALac	I	6	157.6762838	24.41479565	9.96729859	25.62175670
## 22	TOTALac	MM	6	207.9887303	11.65695743	4.75893294	12.23322658
## 23	TOTALac	M	6	227.2735377	4.28462553	1.74919105	4.49643873
## 24	TOTALac	SM	6	224.3113107	13.98740598	5.71033458	14.67888234
## 25	<NA>	I	6	266.8807917	8.48194315	3.46273879	8.90125343
## 26	<NA>	MM	6	301.6803547	34.61672247	14.13221777	36.32802229

```
## 27      <NA>   M 6 350.6257562 31.18238676 12.73015609 32.72390800
## 28      <NA>  SM 6 428.3680832 26.75277911 10.92177634 28.07531986
## 29     ACIDS   I 6 157.6762838 24.41479565  9.96729859 25.62175670
## 30     ACIDS  MM 6 207.9887302 11.65695733  4.75893290 12.23322648
## 31     ACIDS   M 6 227.2735378  4.28462561  1.74919108  4.49643882
## 32     ACIDS  SM 6 224.3113107 13.98740581  5.71033451 14.67888217
```

Concentración del ratio azúcares totales / ácidos orgánicos totales a distintos estados.

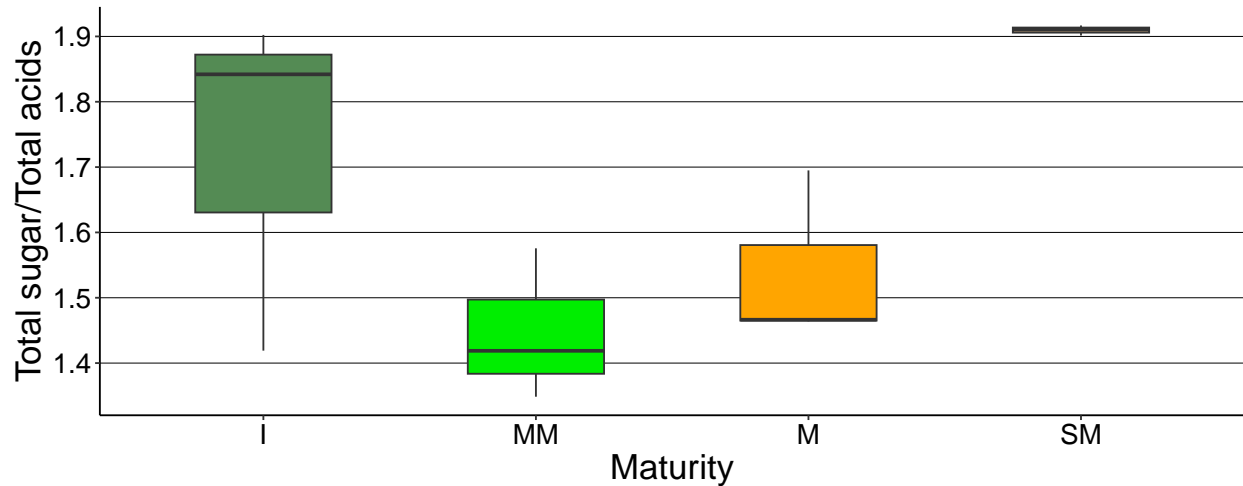
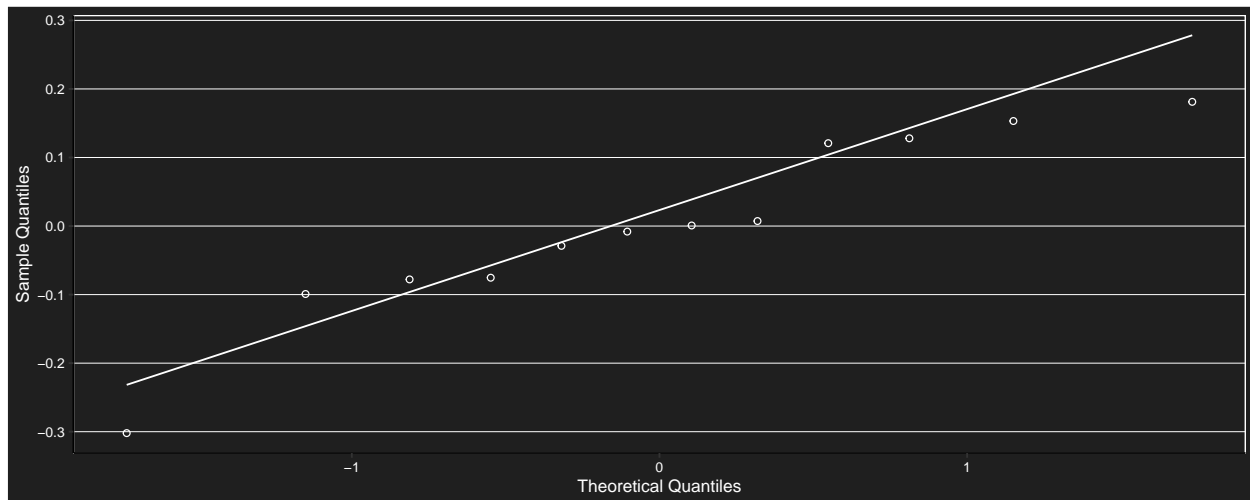
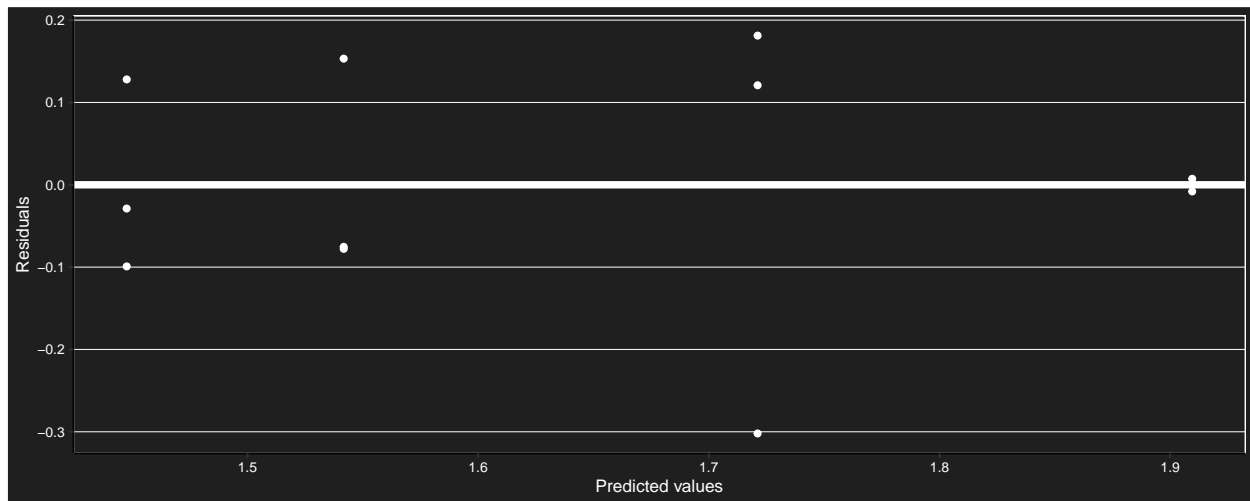


Tabla descriptiva totales

```
##      MAD N  TOTALS      sd      se      ci
## 1    I 3 1.721122 0.263331773 0.152034670 0.65415239
## 2    MM 3 1.447652 0.116290919 0.067140593 0.28888266
## 3     M 3 1.541716 0.132691300 0.076609358 0.32962346
## 4    SM 3 1.909504 0.007733369 0.004464862 0.01921075
```

Relación ST/AT (azúcares totales / ácidos totales)

```
## Linear mixed-effects model fit by REML
## Data: dataSTAT
## Log-restricted-likelihood: 1.185396
## Fixed: TOTALS ~ MAD
## (Intercept)      MADMM      MADM      MADSM
## 1.7211225 -0.2734708 -0.1794066 0.1883818
##
## Random effects:
## Formula: ~1 | REP
## (Intercept) Residual
## StdDev: 0.0009997037 0.158534
##
## Number of Observations: 12
## Number of Groups: 3
```



```
##
## Shapiro-Wilk normality test
##
## data: e
## W = 0.92623, p-value = 0.3418
```

Anova

```
##          numDF denDF   F-value p-value
## (Intercept)      1      6 1307.5624  <.0001
## MAD              3      6   4.9724  0.0457
```

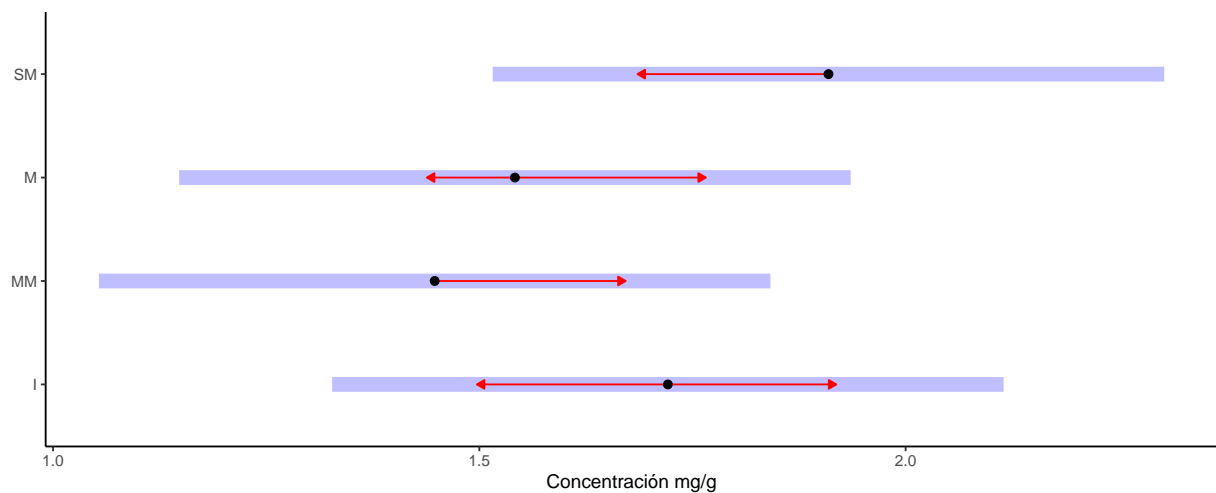
Test de Tukey

```
## $emmeans
## MAD emmean      SE df lower.CL upper.CL
## I      1.72 0.0915  2     1.33     2.11
```

```

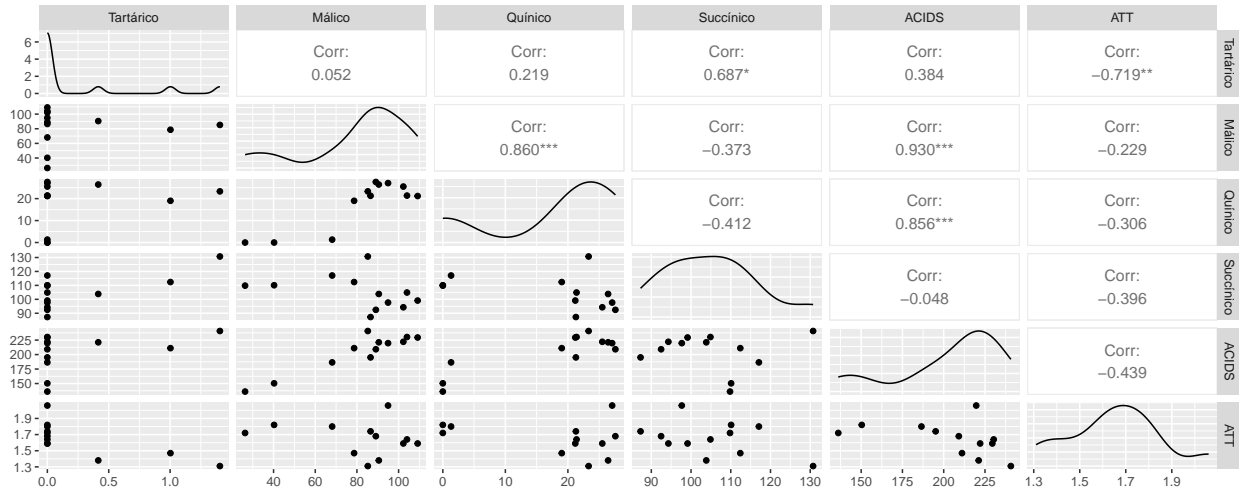
## MM      1.45 0.0915 2      1.05      1.84
## M       1.54 0.0915 2      1.15      1.94
## SM      1.91 0.0915 2      1.52      2.30
##
## Degrees-of-freedom method: containment
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate      SE df t.ratio p.value
## I - MM      0.2735 0.129 6      2.113 0.2498
## I - M       0.1794 0.129 6      1.386 0.5497
## I - SM     -0.1884 0.129 6     -1.455 0.5142
## MM - M     -0.0941 0.129 6     -0.727 0.8831
## MM - SM    -0.4619 0.129 6     -3.568 0.0443
## M - SM     -0.3678 0.129 6     -2.841 0.1041
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 4 estimates

```



## Correlaciones

Correlaciones de Pearson.



```
##
## Pearson's product-moment correlation
##
## data: FACO$Málico and FACO$Quínico
## t = 5.3299, df = 10, p-value = 0.000333
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## 0.5649710 0.9600656
## sample estimates:
##      cor
## 0.8600213

##
## Pearson's product-moment correlation
##
## data: FACO$Tartárico and FACO$Succínico
## t = 2.9895, df = 10, p-value = 0.01358
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## 0.1866812 0.9043389
## sample estimates:
##      cor
## 0.6869819

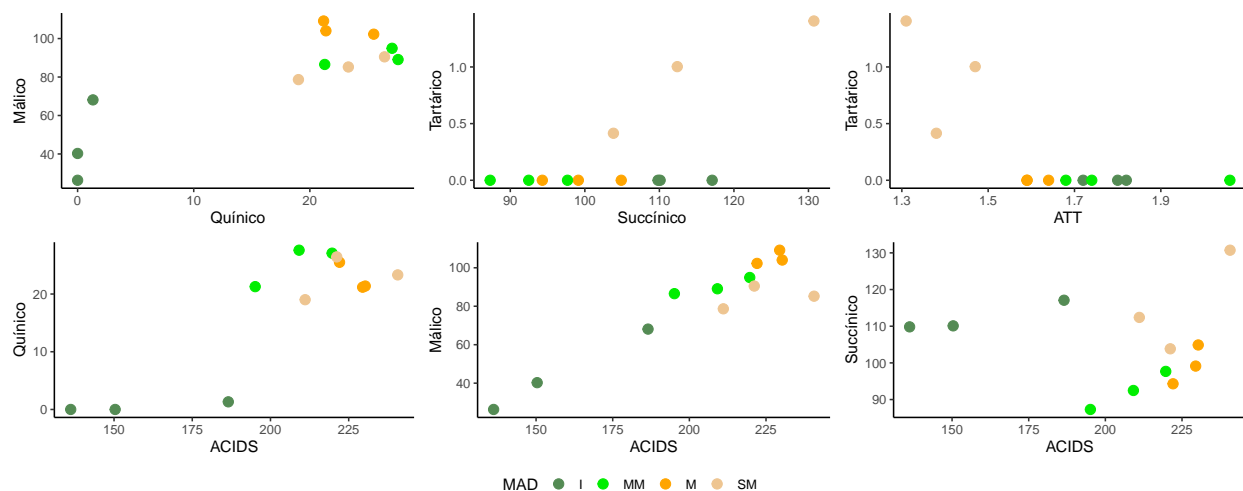
##
## Pearson's product-moment correlation
##
## data: FACO$ATT and FACO$Tartárico
## t = -3.2686, df = 10, p-value = 0.00845
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## -0.9151410 -0.2464551
## sample estimates:
##      cor
## -0.7187027

##
```

```
## Pearson's product-moment correlation
##
## data: FAC0$ACIDS and FAC0$Quínico
## t = 5.2307, df = 10, p-value = 0.0003839
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## 0.5539018 0.9587847
## sample estimates:
## cor
## 0.8557676

##
## Pearson's product-moment correlation
##
## data: FAC0$ACIDS and FAC0$Málico
## t = 8.0069, df = 10, p-value = 1.169e-05
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## 0.7639902 0.9805782
## sample estimates:
## cor
## 0.9300893
```

Gráficos de correlación detallados por estado.



- Correlaciones: Se evidenciaron relaciones lineales entre los ácidos orgánicos, entre el ácido málico y el ácido quínico con un coeficiente de correlación ( $r$ ) de 0.8600213 y un valor de  $p=0.000333$ , y entre el ácido tartárico y el ácido succínico con un  $r=0.6869819$  y un  $p\text{-valor}=0.01358$ . La acidez titulable total (TTA) mostró una asociación lineal significativa únicamente con el ácido tartárico, con un  $r=-0.7187027$  y un  $p\text{-valor}=0.00845$ . Sin embargo, esta asociación inversa está vinculada al hecho de que el ácido tartárico solo aparece en cantidades mínimas en frutas muy maduras. La concentración total de ácidos con ácido quínico presentó una correlación de 0.8557676 con un  $p\text{-valor}=0.0003839$ . Mientras tanto, el ácido málico mostró un  $r=0.9300893$  y un  $p\text{-valor}=1.169e-05$ . En ambos casos, estos ácidos explican el aumento en la concentración total de ácidos a lo largo del proceso de maduración de la fruta.