TFM_E2_Grupo02

2023-06-08

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(factoextra)
```

```
## Loading required package: ggplot2
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
library(ggplot2)
library(cluster)
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✓ forcats   1.0.0     ✓ stringr   1.5.0
## ✓ lubridate 1.9.2     ✓ tibble    3.2.1
## ✓ purrr     1.0.1     ✓ tidyr     1.3.0
## ✓ readr     2.1.4
```

```
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becom
e errors
```

```
library(ggcorrplot)
library(writexl)
```

```
## Warning: package 'writexl' was built under R version 4.3.1
```

```
library(openxlsx)
```

```
## Warning: package 'openxlsx' was built under R version 4.3.1
```

```
library(PerformanceAnalytics)
```

```
## Warning: package 'PerformanceAnalytics' was built under R version 4.3.1
```

```
## Loading required package: xts
## Loading required package: zoo
##
## Attaching package: 'zoo'
##
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
##
##
## ############################ Warning from 'xts' package ##########################
## #                                                                                #
## # The dplyr lag() function breaks how base R's lag() function is supposed to  #
## # work, which breaks lag(my_xts). Calls to lag(my_xts) that you type or       #
## # source() into this session won't work correctly.                               #
## #                                                                                #
## # Use stats::lag() to make sure you're not using dplyr::lag(), or you can add #
## # conflictRules('dplyr', exclude = 'lag') to your .Rprofile to stop           #
## # dplyr from breaking base R's lag() function.                                   #
## #                                                                                #
## # Code in packages is not affected. It's protected by R's namespace mechanism #
## # Set `options(xts.warn_dplyr_breaks_lag = FALSE)` to suppress this warning.  #
## #                                                                                #
## ##################################################################################
##
## Attaching package: 'xts'
##
## The following objects are masked from 'package:dplyr':
##
##     first, last
##
##
## Attaching package: 'PerformanceAnalytics'
##
## The following object is masked from 'package:graphics':
##
##     legend
```

```
library(corrplot)
```

```
## corrplot 0.92 loaded
```

```
#cargamos los datos con las variables que nos interesan
#df1 = data.frame(read.csv2('C:/Users/linfante/OneDrive/Documentos/MasterBigData/TFM/tfm_master_
ds/1 - BackEnd/Datos/alimentos v3.csv', sep=','))
#df2 = data.frame(read.csv2('C:/Users/linfante/OneDrive/Documentos/MasterBigData/TFM/tfm_master_
ds/1 - BackEnd/Datos/alimentos_vegan.csv', sep=','))
df = data.frame(read.csv2('C:/Users/linfante/OneDrive/Documentos/MasterBigData/TFM/tfm_master_d
s/1 - BackEnd/Datos/alimentos v4.csv', sep=','))
```

```
#df <- df[,c("PRODUCT_NAME","PROTEINS_100G","CARBOHYDRATES_100G","FAT_100G","FIBER_100G","SALT_1
00G","SATURATED_FAT_100G","SUGARS_100G")]
df <- df[,c("PRODUCT_NAME","PROTEINS_100G","CARBOHYDRATES_100G","FAT_100G")]
```

```
PRODUCT_NAME <- df[,1]

# Filtrar las columnas que contienen el texto "_100G"
#columnas_filtradas <- grep("_100G", colnames(df))
#df <- df[, columnas_filtradas]
#df <- cbind(PRODUCT_NAME,df)

#Convertir a numerico todo
df_nuevo <- df %>%
  mutate(across(where(is.character), type.convert, as.is = TRUE)) %>%
  select_if(is.numeric)
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `across(where(is.character), type.convert, as.is = TRUE)`.
## Caused by warning:
## ! The `...` argument of `across()` is deprecated as of dplyr 1.1.0.
## Supply arguments directly to `.fns` through an anonymous function instead.
##
##   # Previously
##   across(a:b, mean, na.rm = TRUE)
##
##   # Now
##   across(a:b, \(x) mean(x, na.rm = TRUE))
```

```
total <- as.data.frame(colSums(df_nuevo))
totalc <- as.data.frame(rowSums(df_nuevo))
```

```
totales <- colSums(df_nuevo)

# Seleccionar las columnas con un total mayor o igual a 5
#columnas_a_mantener <- totales >= 10000

# Eliminar las columnas con un total inferior a 30
#df_nuevo <- df_nuevo[, columnas_a_mantener]
PRODUCT_NAME <- df[,1]
df_nuevo <- cbind(PRODUCT_NAME,df_nuevo)
```

```
#elimina vectores fila nulos
df_nuevo$suma <- rowSums(df_nuevo[, c("PROTEINS_100G","CARBOHYDRATES_100G","FAT_100G")])
df_nuevo <- subset(df_nuevo, !(suma == 0))
df_nuevo <- df_nuevo[,c("PRODUCT_NAME","PROTEINS_100G","CARBOHYDRATES_100G","FAT_100G")]
df_nuevo <- na.omit(df_nuevo)
```

```
#filtros negativos
# Crear un vector con las palabras a buscar
palabras_a_eliminar <- c("SALSA DE SOJA","SAUCE SOJA", "SAUCE SOJA","BEBIDA DE SOJA", "YAOURT SO
JA","YOGURT DE SOJA","CHOCOLAT","ARROZ Y SOJA","LECHE","MOUSSE","MILK","ACEITE","DESSERT","PAN S
OJA","BOISSON SOJA", "GLACE","ML","SAUCE DE SOJA","SAUCE","SALSA","BIBEDA DE SOJA","LAIT SOJ
A","VIVESOY SOJA","LAIT DE SOJA","YAOURT","POSTRE","MUESLI","YOGUR","BEBIDA","MARGARINA","VINAIG
RETTE","DRINK","SAUCE","BATIDO","LAIT","MAYONNAISE","CAFE","VANILLE","NATA","YOGURT")

# Crear una función que verifica si alguna de las palabras está presente en el texto
verificar_palabras <- function(texto, palabras) {
  sapply(palabras, function(palabra) grepl(palabra, texto))
}
# Identificar las filas que contienen alguna de las palabras a eliminar
filas_a_eliminar <- apply(df_nuevo, 1, function(row) any(verificar_palabras(row["PRODUCT_NAME"],
palabras_a_eliminar)))

# Eliminar las filas identificadas del dataframe original
df_nuevo1 <- df_nuevo[!filas_a_eliminar, ]
#df_nuevo2 <- df_nuevo1[,-1]

#Elimino los faltantes
df_nuevo1 <- df_nuevo1[complete.cases(df_nuevo1), ]
```

```
df_soja <- subset(df_nuevo1, grepl("soja", PRODUCT_NAME, ignore.case = TRUE)) ## Registros que c
ontienen la palabra "soja"
df_seitan <- subset(df_nuevo1, grepl("seitan", PRODUCT_NAME, ignore.case = TRUE)) ## Registros q
ue contienen la palabra "seitan"
df_tofu <- subset(df_nuevo1, grepl("tofu", PRODUCT_NAME, ignore.case = TRUE)) ## Registros que c
ontienen la palabra "tofu"
df_tofu <- na.omit(df_tofu)
```

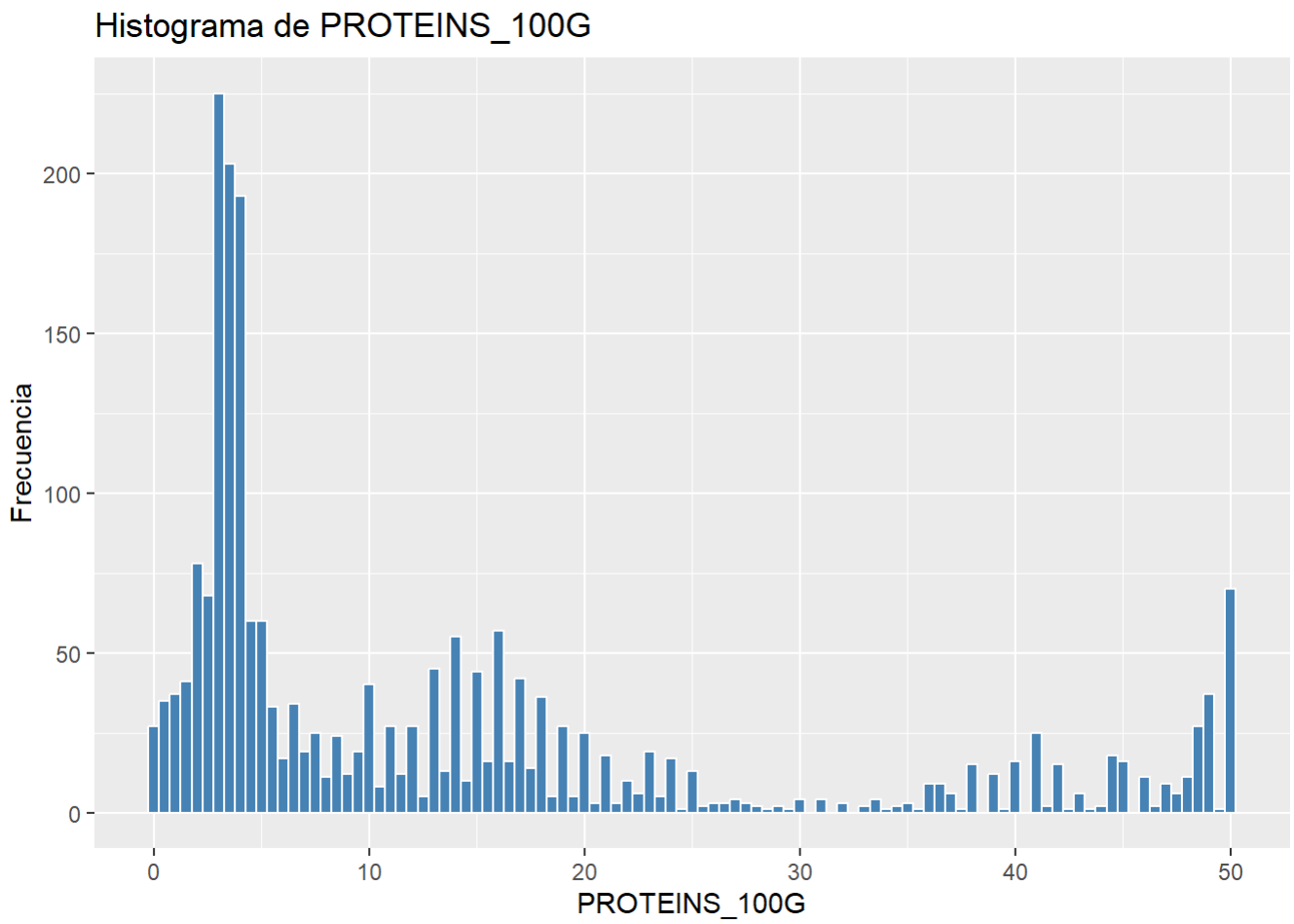
```
# Definir la función para eliminar valores atípicos basados en desviación estándar
remove_outliers <- function(data, column, sd_threshold = 2) {
  data[abs(scale(data[[column]])) < sd_threshold, ]
}
# Eliminar valores atípicos en columna1 utilizando desviación estándar
df_soja <- remove_outliers(df_soja, "PROTEINS_100G")
df_soja <- remove_outliers(df_soja, "CARBOHYDRATES_100G")
df_soja <- remove_outliers(df_soja, "FAT_100G")
#df_soja <- remove_outliers(df_soja, "SUGARS_100G")

# Eliminar valores atípicos en columna1 utilizando desviación estándar
df_seitan <- remove_outliers(df_seitan, "PROTEINS_100G")
df_seitan <- remove_outliers(df_seitan, "CARBOHYDRATES_100G")
df_seitan <- remove_outliers(df_seitan, "FAT_100G")
#df_seitan <- remove_outliers(df_seitan, "SUGARS_100G")

# Eliminar valores atípicos en columna1 utilizando desviación estándar
df_tofu <- remove_outliers(df_tofu, "PROTEINS_100G")
df_tofu <- remove_outliers(df_tofu, "CARBOHYDRATES_100G")
df_tofu <- remove_outliers(df_tofu, "FAT_100G")
#df_tofu <- remove_outliers(df_tofu, "SUGARS_100G")
```

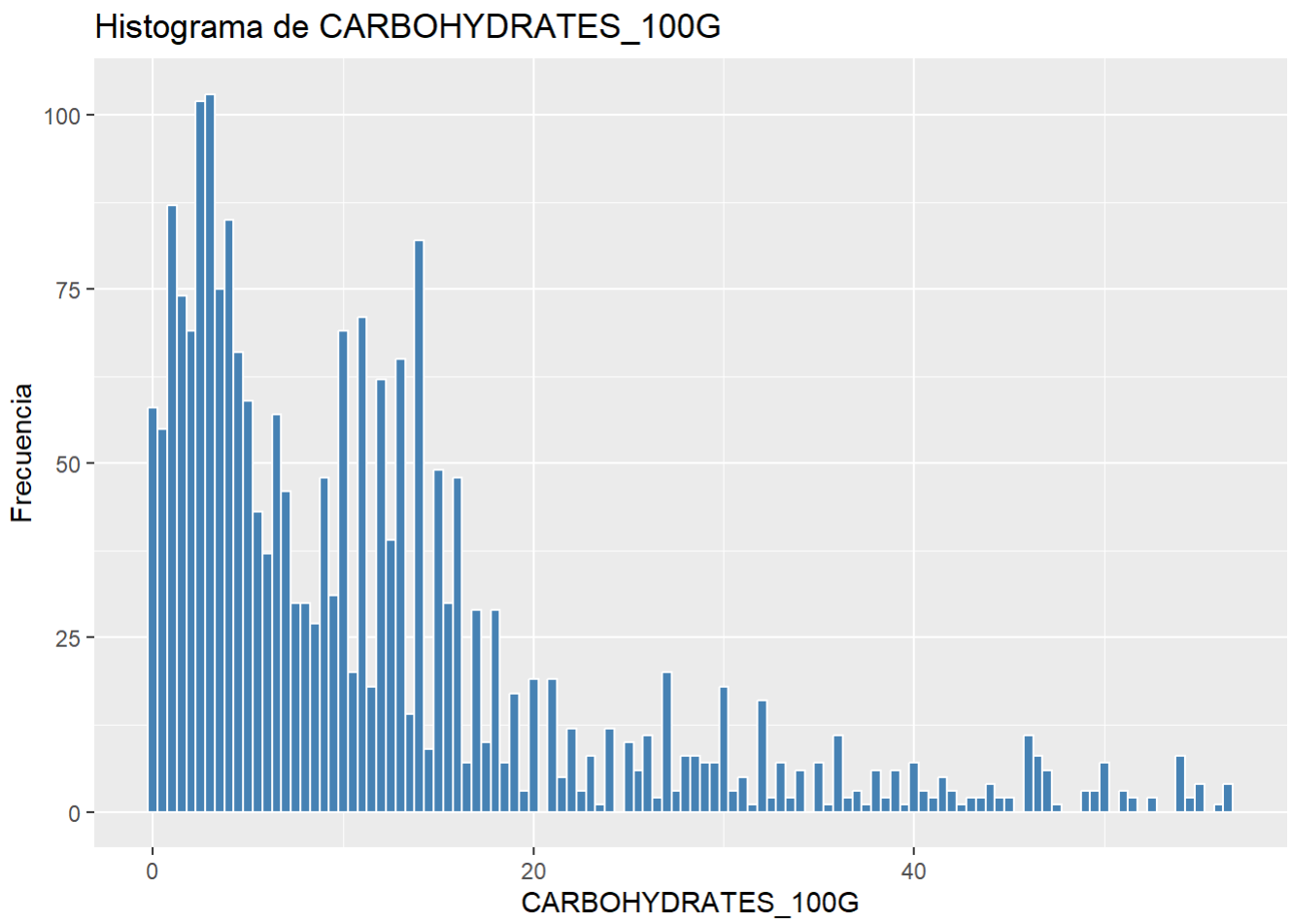
SOja

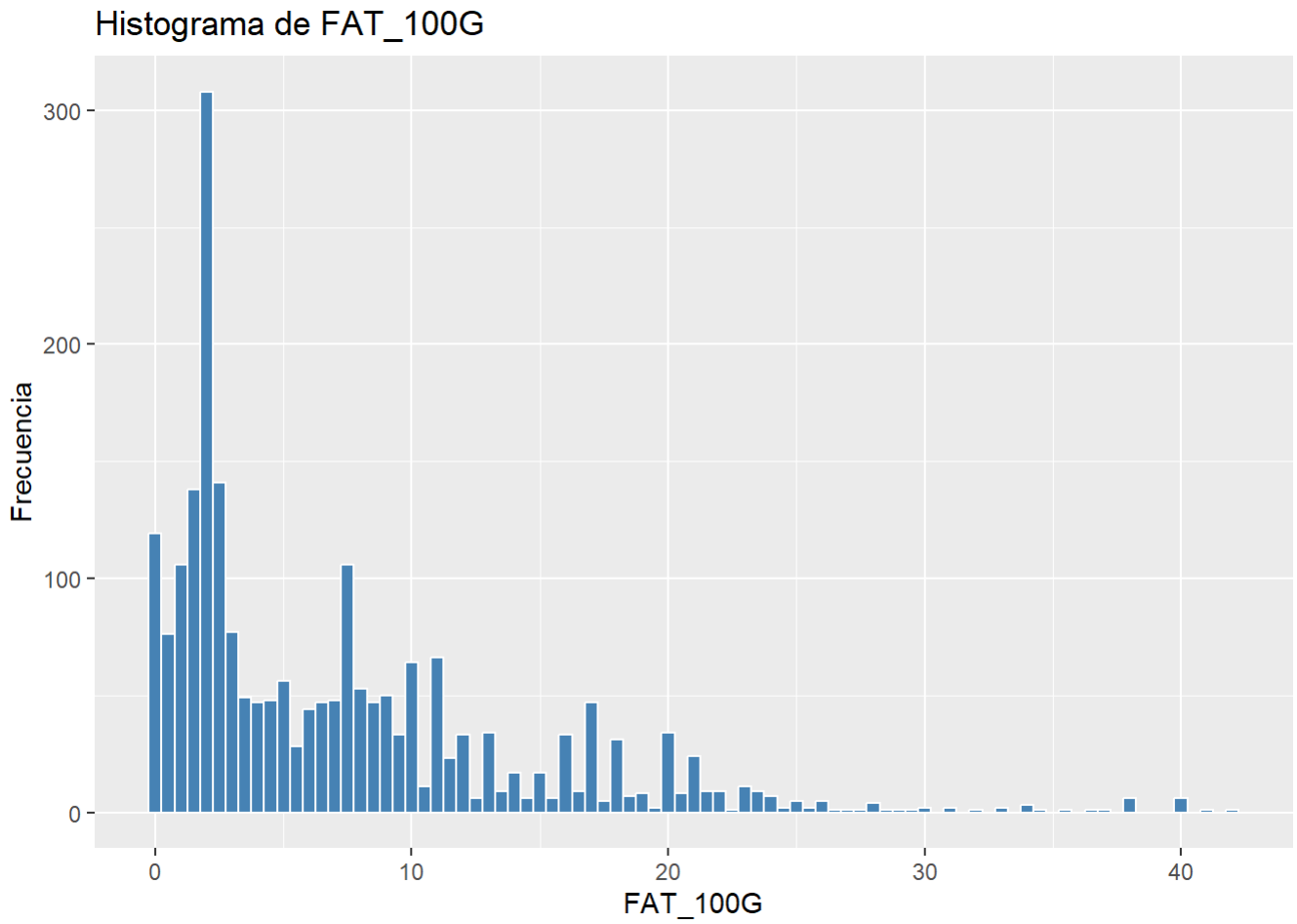
```
summary(df_soja)
```

```
##  PRODUCT_NAME       PROTEINS_100G   CARBOHYDRATES_100G    FAT_100G
##  Length:2219        Min.   : 0.00   Min.   : 0.00      Min.   : 0.000
##  Class :character   1st Qu.: 3.40   1st Qu.: 3.30      1st Qu.: 2.000
##  Mode  :character   Median : 6.70   Median : 8.90      Median : 4.800
##                     Mean   :13.89   Mean   :11.65      Mean   : 7.118
##                     3rd Qu.:18.00   3rd Qu.:15.00      3rd Qu.:10.000
##                     Max.   :50.00   Max.   :56.50      Max.   :41.800
```

```
# Obtener las columnas cuantitativas del dataframe
columnas_cuantitativas <- sapply(df_soja, is.numeric)

# Crear un histograma para cada columna cuantitativa
for (columna in names(df_soja[columnas_cuantitativas])) {
  plot_data <- df_soja[, columna]
  p <- ggplot(data.frame(x = plot_data), aes(x)) +
    geom_histogram(binwidth = 0.5, fill = "steelblue", color = "white") +
    labs(title = paste("Histograma de", columna),
         x = columna,
         y = "Frecuencia")

  print(p)
}
```


Histograma de PROTEINS_100G
Frecuencia
0
50
100
150
200
0
10
20
30
40
50
PROTEINS_100G

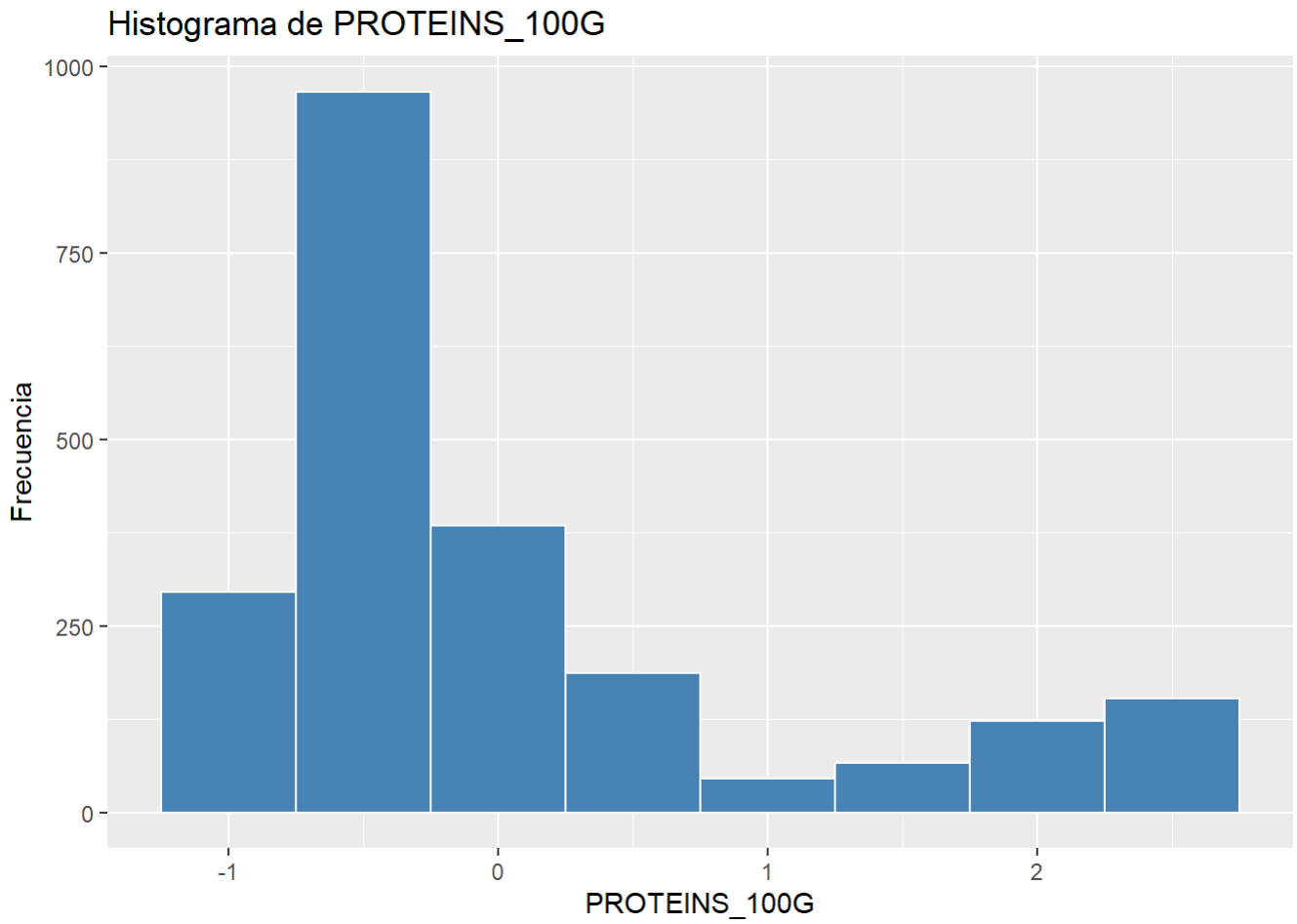

Histograma de CARBOHYDRATES_100G
Frecuencia
0
25
50
75
100
0
20
40
CARBOHYDRATES_100G

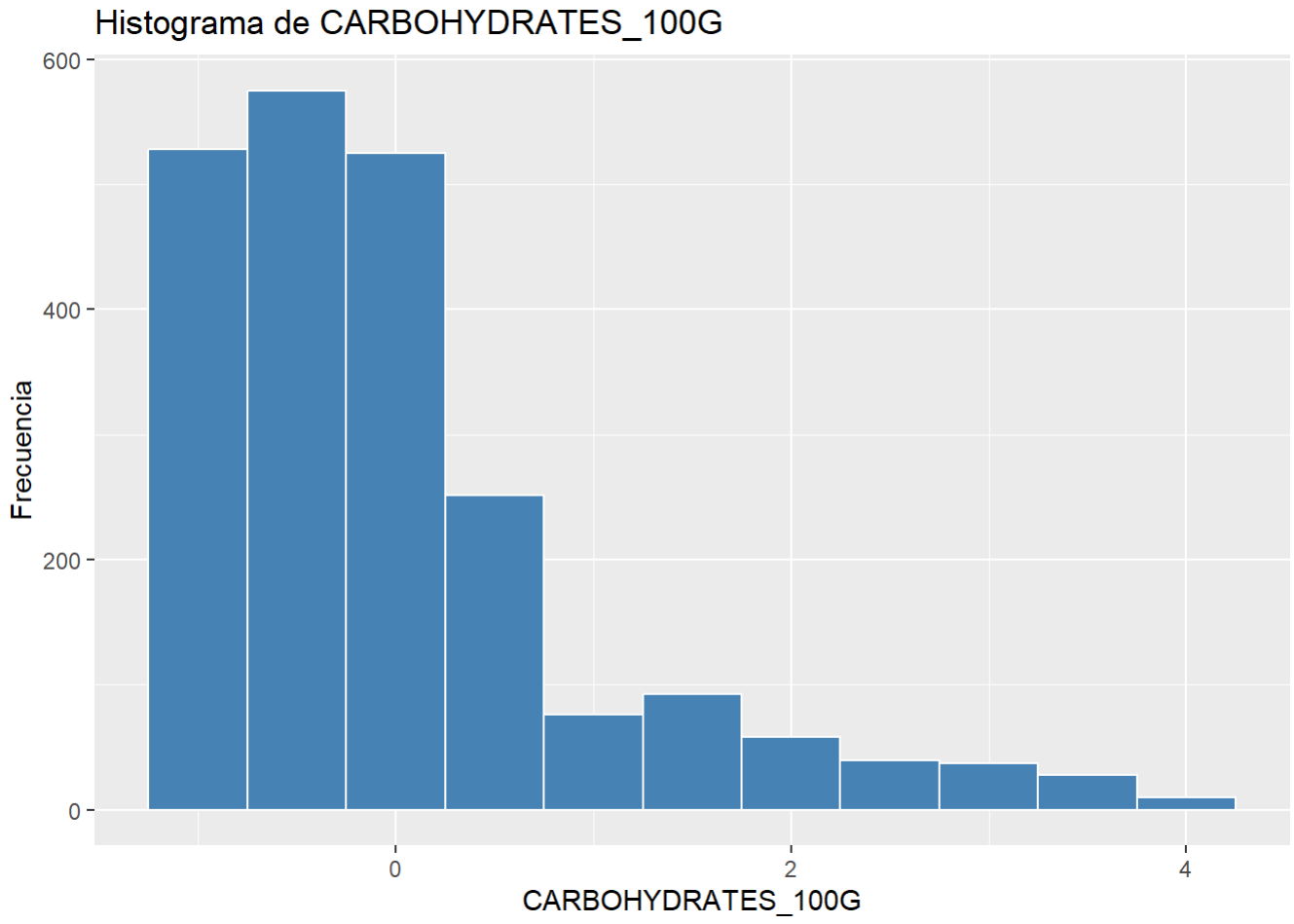


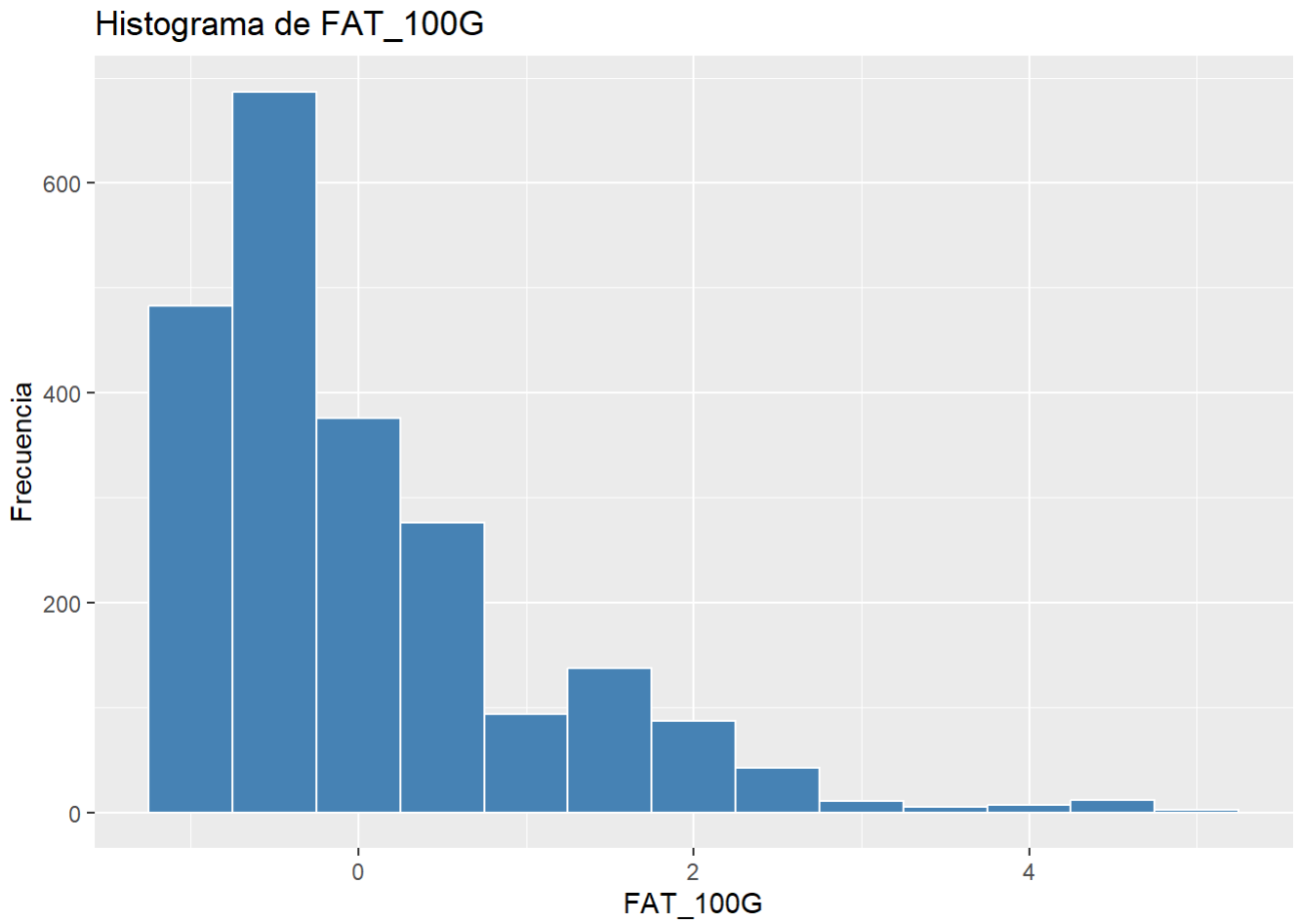

```
s_soja <- scale(df_soja[,-1])
s_soja1 <- as.data.frame(s_soja)
summary(s_soja)
```

```
##  PROTEINS_100G     CARBOHYDRATES_100G    FAT_100G
##  Min.   :-0.9430   Min.   :-1.0186    Min.   :-1.0103
##  1st Qu.:-0.7122   1st Qu.:-0.7300    1st Qu.:-0.7264
##  Median :-0.4882   Median :-0.2403    Median :-0.3290
##  Mean   : 0.0000   Mean   : 0.0000    Mean   : 0.0000
##  3rd Qu.: 0.2790   3rd Qu.: 0.2931    3rd Qu.: 0.4092
##  Max.   : 2.4514   Max.   : 3.9222    Max.   : 4.9231
```

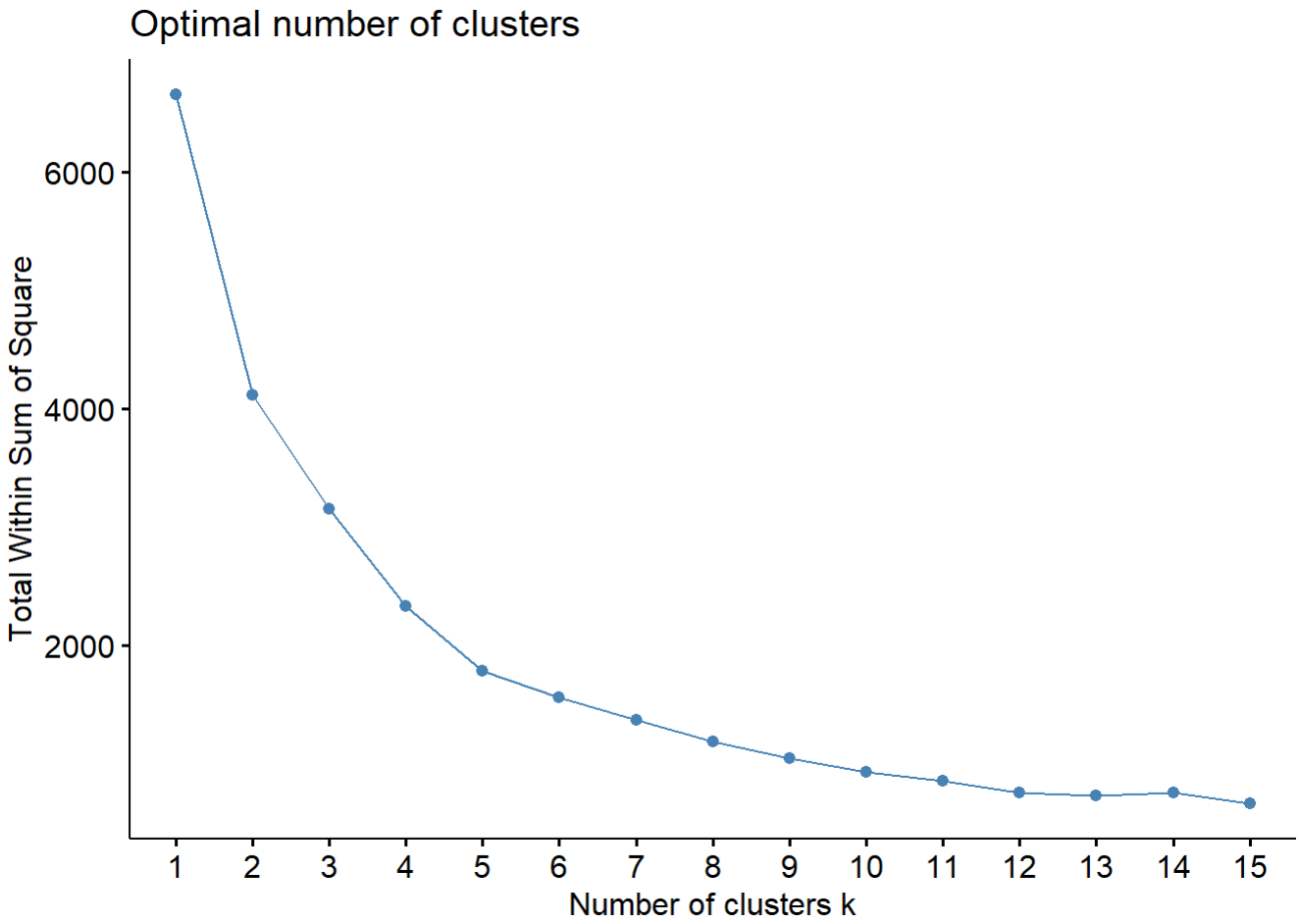
```
# Obtener las columnas cuantitativas del dataframe
columnas_cuantitativas <- sapply(s_soja1, is.numeric)

# Crear un histograma para cada columna cuantitativa
for (columna in names(s_soja1[columnas_cuantitativas])) {
  plot_data <- s_soja1[, columna]
  p <- ggplot(data.frame(x = plot_data), aes(x)) +
    geom_histogram(binwidth = 0.5, fill = "steelblue", color = "white") +
    labs(title = paste("Histograma de", columna),
         x = columna,
         y = "Frecuencia")

  print(p)
}
```


Histograma de PROTEINS_100G
Frecuencia
1000
750
500
250
0
-1
0
1
2
PROTEINS_100G


Histograma de CARBOHYDRATES_100G
Frecuencia
600
400
200
0
0
2
4
CARBOHYDRATES_100G



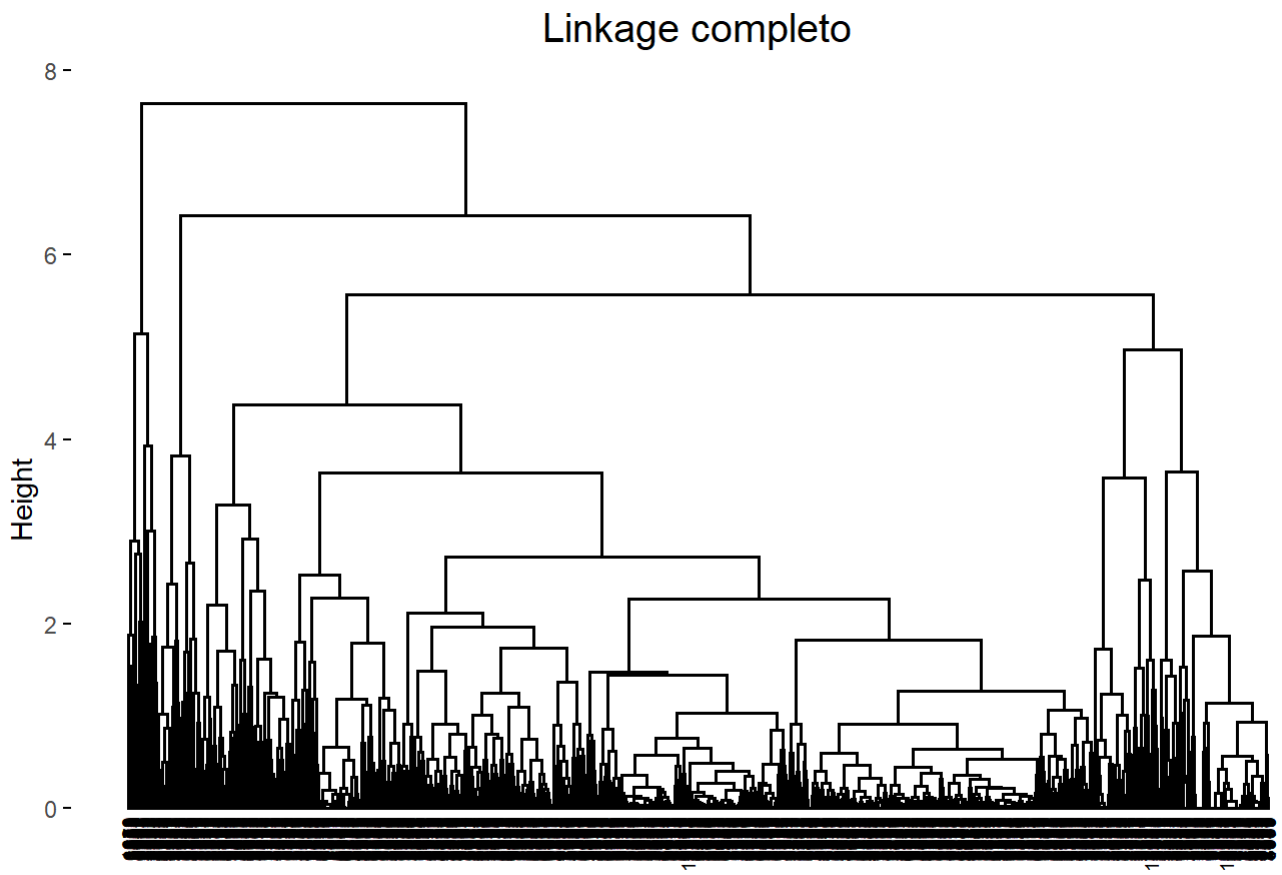

```
#total de cluster óptimos
elbow <- fviz_nbclust(x = s_soja, FUNcluster = kmeans, method = "wss", k.max = 15,
             diss = get_dist(s_soja, method = "euclidean"), nstart = 25)
print(elbow)
```



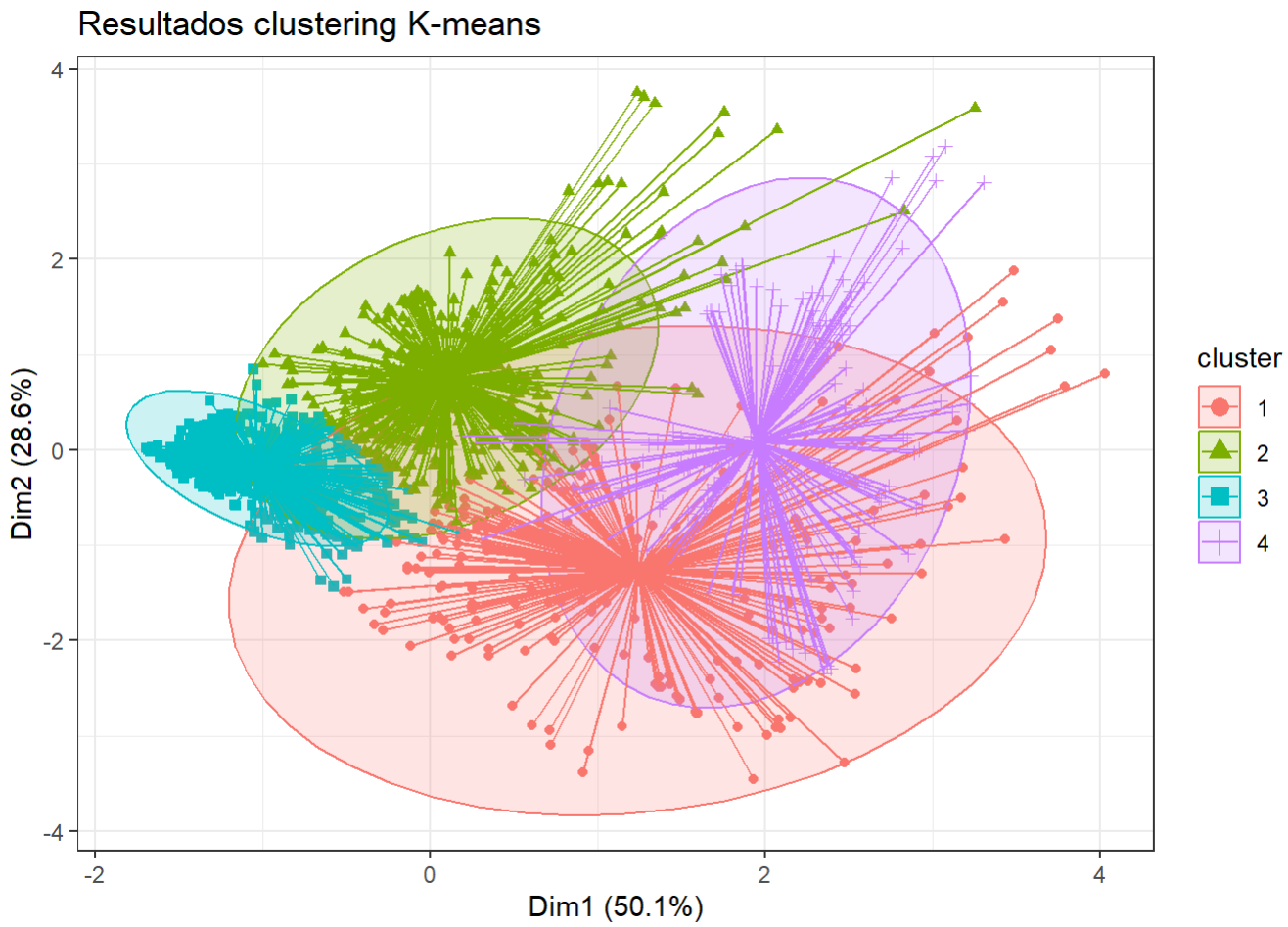

```
#Clustering K-means
set.seed(123)
km_clusters <- kmeans(x=s_soja,centers=4,nstart=25)
fviz_cluster(object=km_clusters,data=s_soja,show.clust.cent = TRUE,
             ellipse.type="euclid",star.plot=TRUE,repel=TRUE,
             pointsize=0.5,outlier.color="darkred") +
  labs(title ="Resultados clustering K-means") +
  theme_bw() +
  theme(legend.position = "none")
```


```
#Dedrograma
set.seed(101)
heculidea <- hclust(d = dist(x = s_soja, method = "euclidean"),
                    method = "complete")

fviz_dend(x=heculidea,cex=0.5,main = "Linkage completo",
               sub="Distancia euclídea")+
        theme(plot.title = element_text(hjust=0.5,size=15))
```

```
## Warning: The `<scale>` argument of `guides()` cannot be `FALSE`. Use "none" instead as
## of ggplot2 3.3.4.
## ℹ The deprecated feature was likely used in the factoextra package.
##   Please report the issue at <https://github.com/kassambara/factoextra/issues>.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```



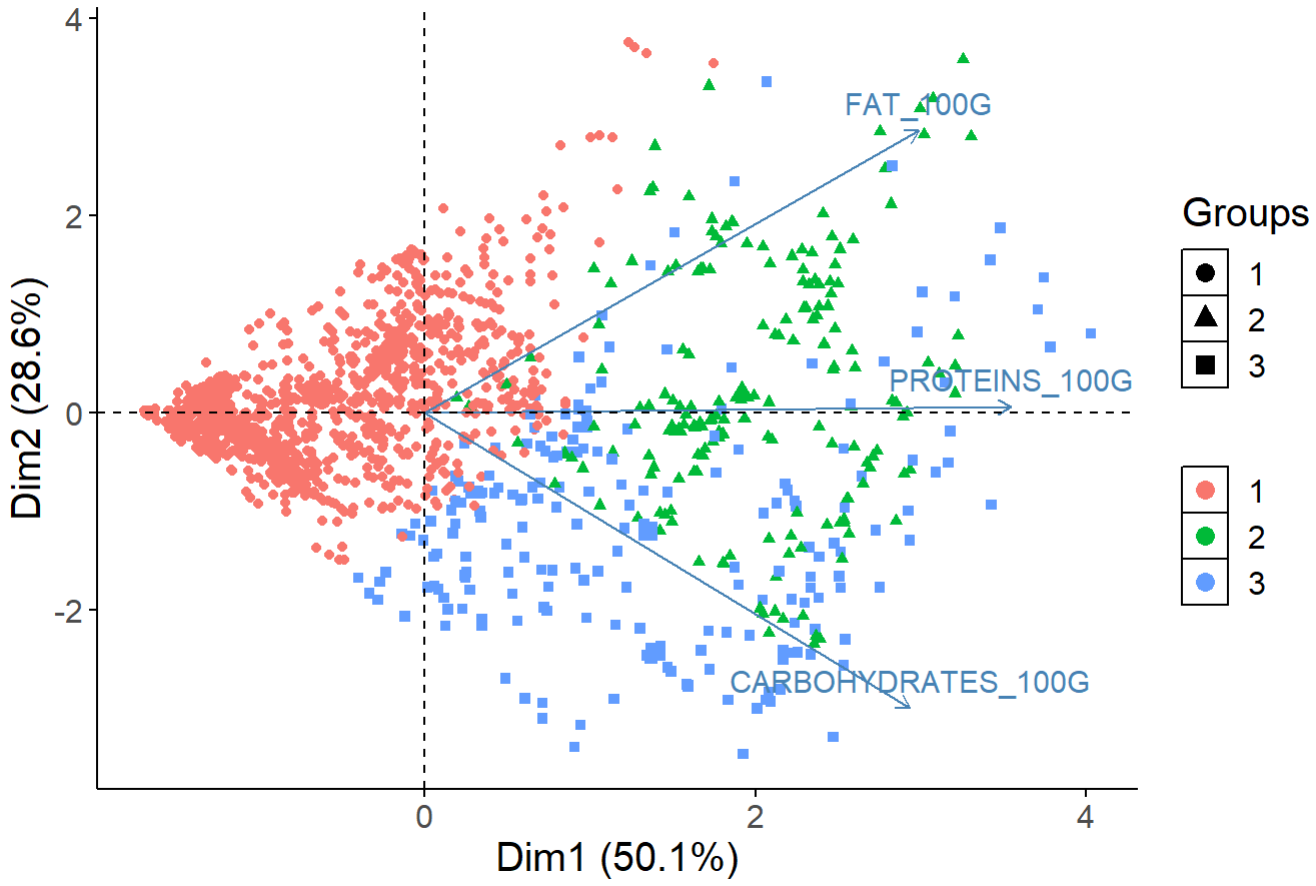

```
#Resultados clustering K-means
require(cluster)
pam.res <- pam(s_soja, 4)
# Visualización
fviz_cluster(pam.res, geom = "point", ellipse.type = "norm",
             show.clust.cent = TRUE,star.plot = TRUE)+
  labs(title = "Resultados clustering K-means")+ theme_bw()
```



Con esta imagen se evidencia que hay cierto grado de conflicto entre los clusters, ya que tienen cierta área solapada entre ambos. Estas representaciones mezclan cluster y PCA, pero no indican el grado de representación de cada variable en cada uno de los componentes.

Biplot PCA y K-Means para medir representatividad soja

```
# PCA
pca <- prcomp(df_soja[,-1], scale=TRUE)
df_soja.pca <- pca$x
# Cluster over the three first PCA dimensions
kc <- kmeans(df_soja.pca[,1:3], 3)
fviz_pca_biplot(pca, label="var", habillage=as.factor(kc$cluster)) +
  labs(color=NULL) + ggtitle("") +
  theme(text = element_text(size = 15),
        panel.background = element_blank(),
        panel.grid.major = element_blank(),
        panel.grid.minor = element_blank(),
        axis.line = element_line(colour = "black"),
        legend.key = element_rect(fill = "white"))
```

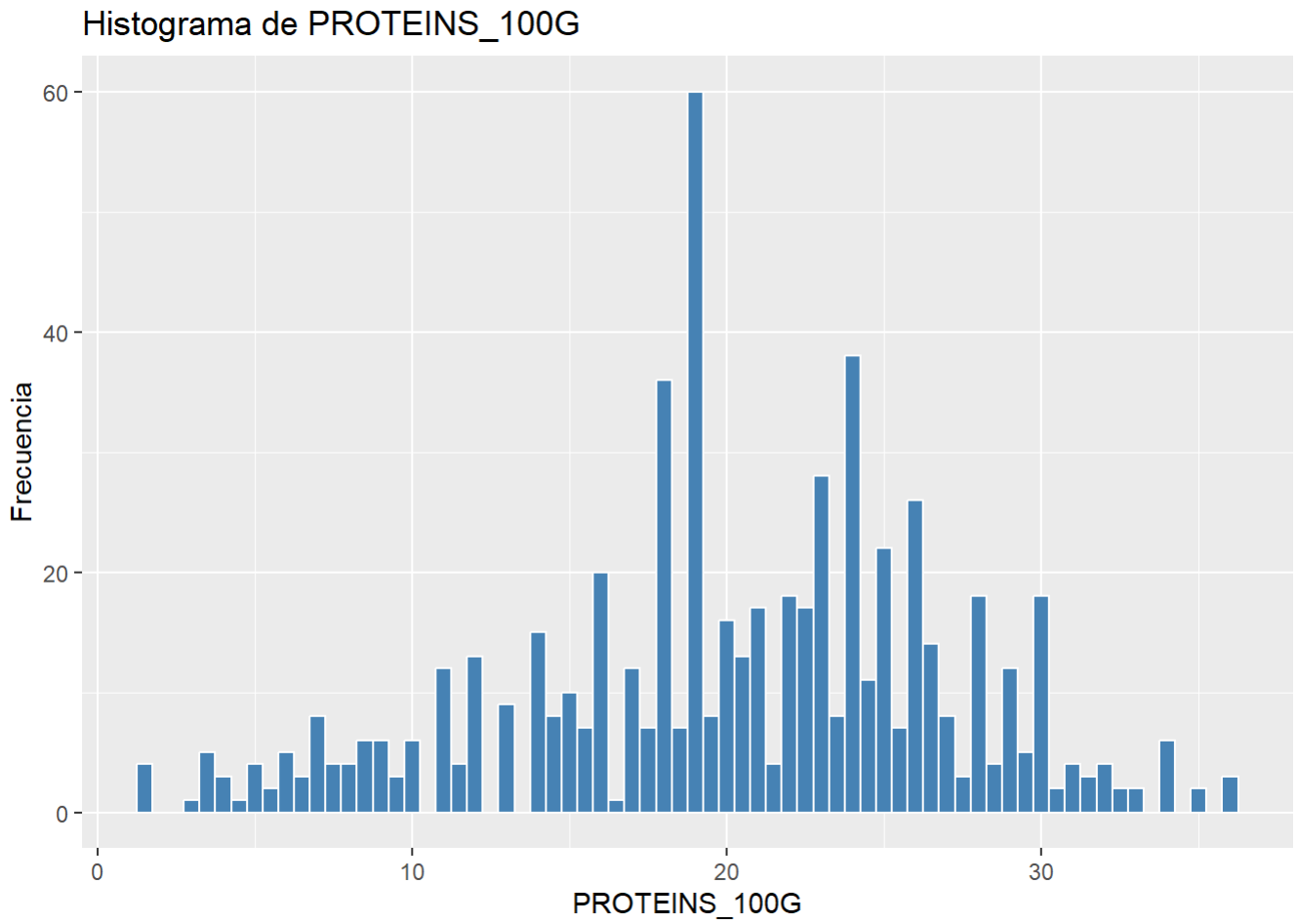


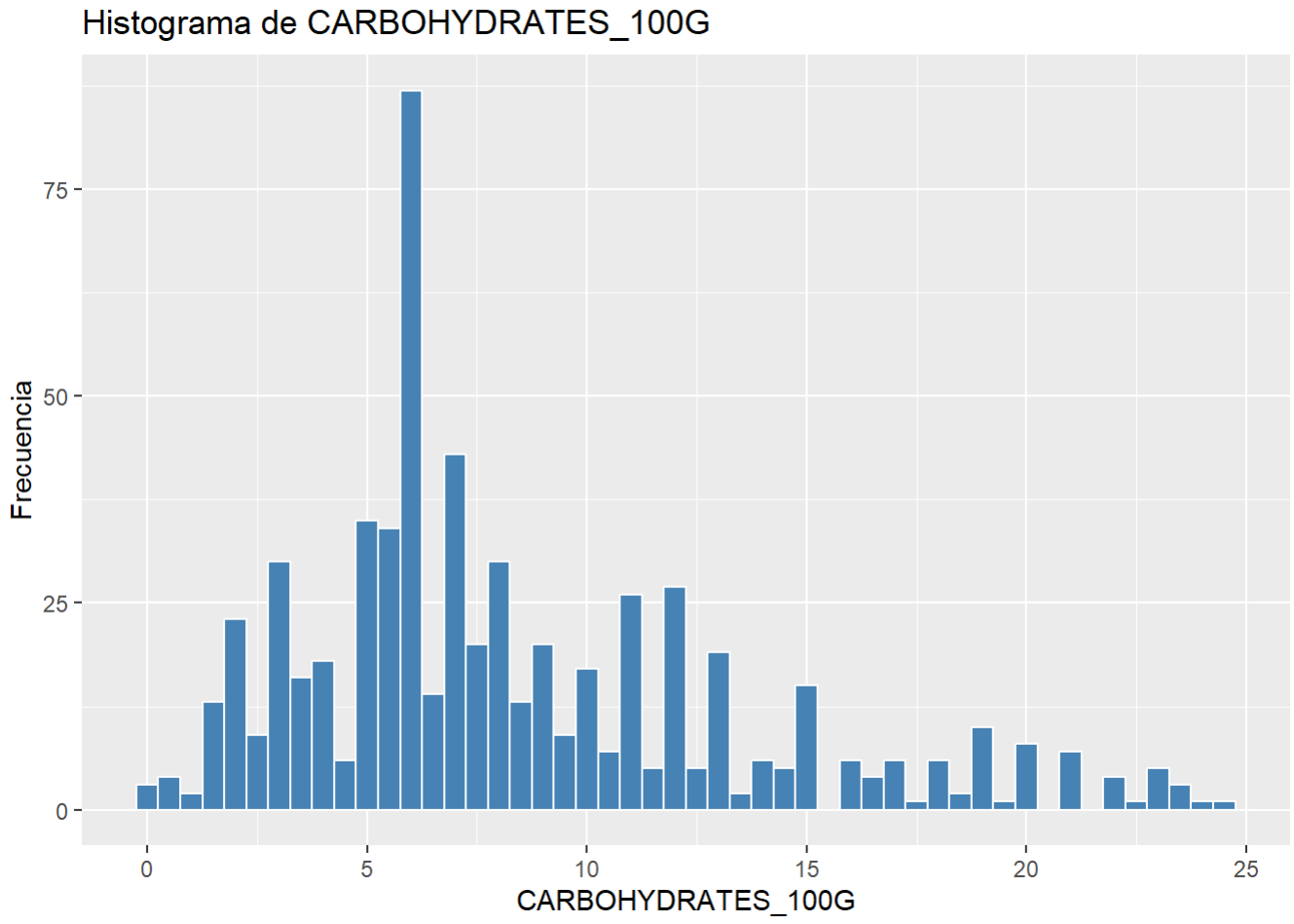
SEITAN

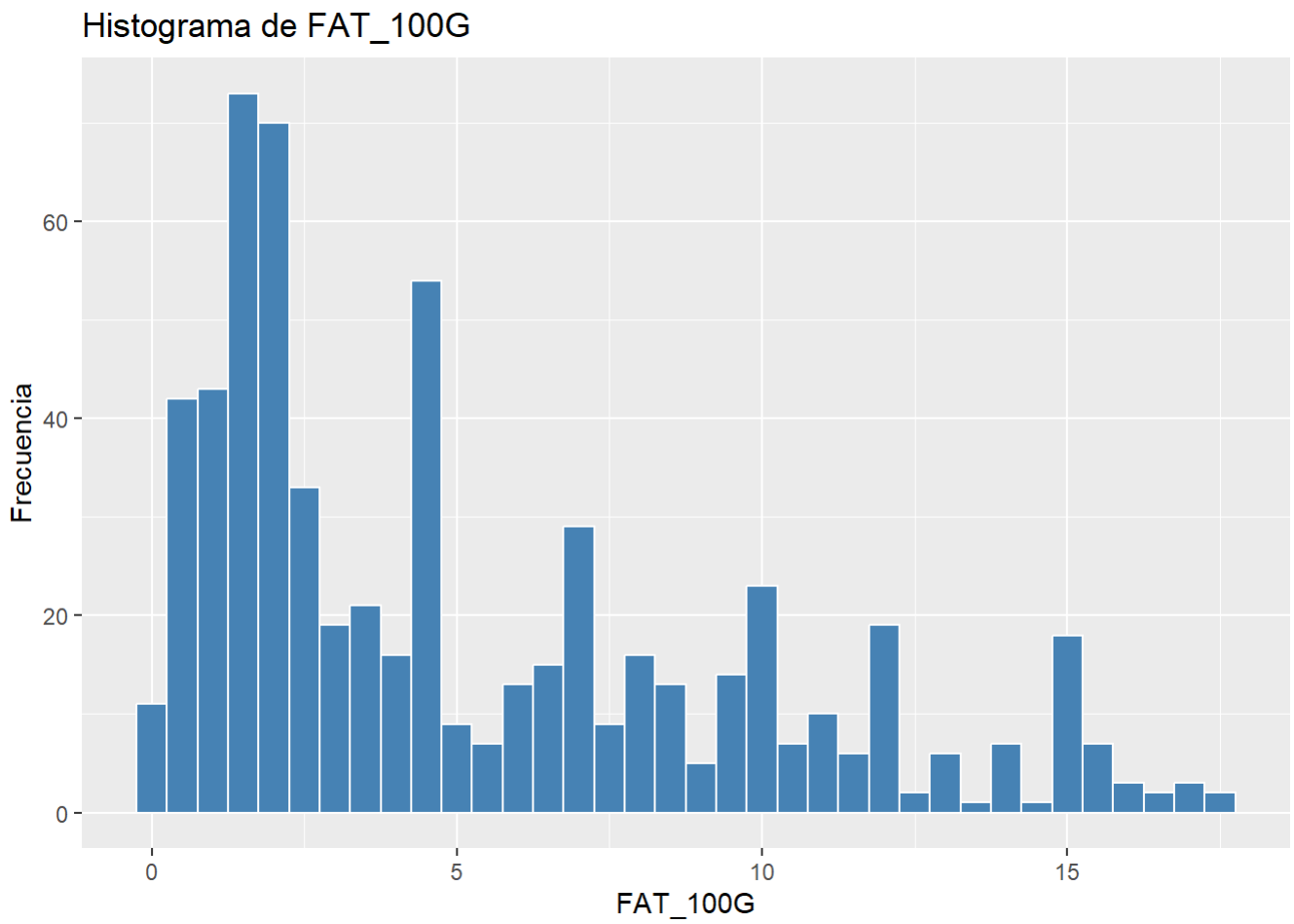
```
summary(df_seitan)
```

```
##  PRODUCT_NAME       PROTEINS_100G   CARBOHYDRATES_100G    FAT_100G
##  Length:629         Min.   : 1.40   Min.   : 0.000     Min.   : 0.000
##  Class :character   1st Qu.:16.00   1st Qu.: 5.200     1st Qu.: 1.600
##  Mode  :character   Median :20.49   Median : 7.000     Median : 3.800
##                     Mean   :20.15   Mean   : 8.419     Mean   : 5.194
##                     3rd Qu.:25.00   3rd Qu.:11.000     3rd Qu.: 8.000
##                     Max.   :36.00   Max.   :24.400     Max.   :17.400
```

```
# Obtener las columnas cuantitativas del dataframe
columnas_cuantitativas <- sapply(df_seitan, is.numeric)

# Crear un histograma para cada columna cuantitativa
for (columna in names(df_seitan[columnas_cuantitativas])) {
  plot_data <- df_seitan[, columna]
  p <- ggplot(data.frame(x = plot_data), aes(x)) +
    geom_histogram(binwidth = 0.5, fill = "steelblue", color = "white") +
    labs(title = paste("Histograma de", columna),
         x = columna,
         y = "Frecuencia")

  print(p)
}
```


Histograma de PROTEINS_100G
Frecuencia
60
40
20
0
0
10
20
30
PROTEINS_100G


Histograma de CARBOHYDRATES_100G
Frecuencia
75
50
25
0
0
5
10
15
20
25
CARBOHYDRATES_100G

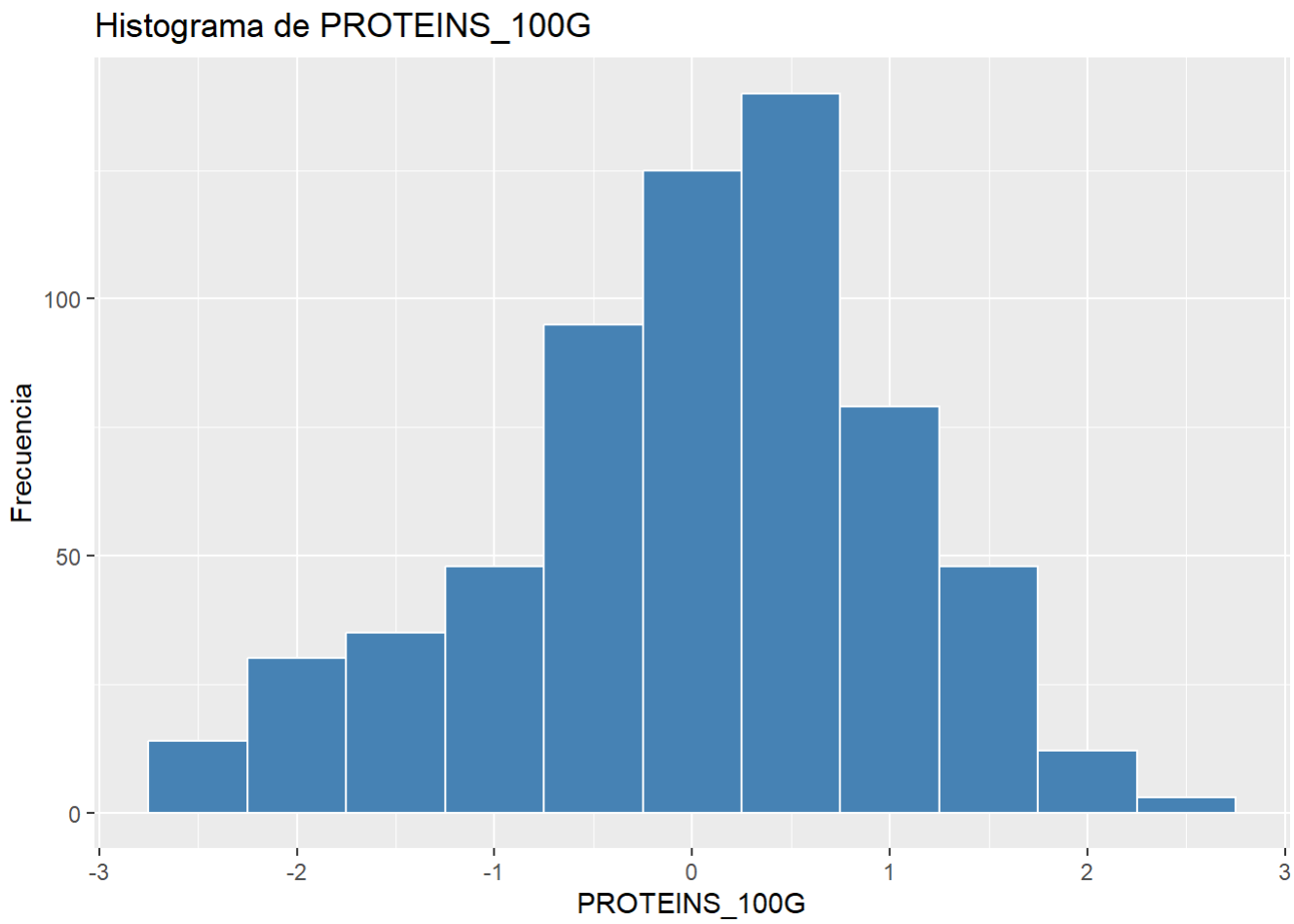


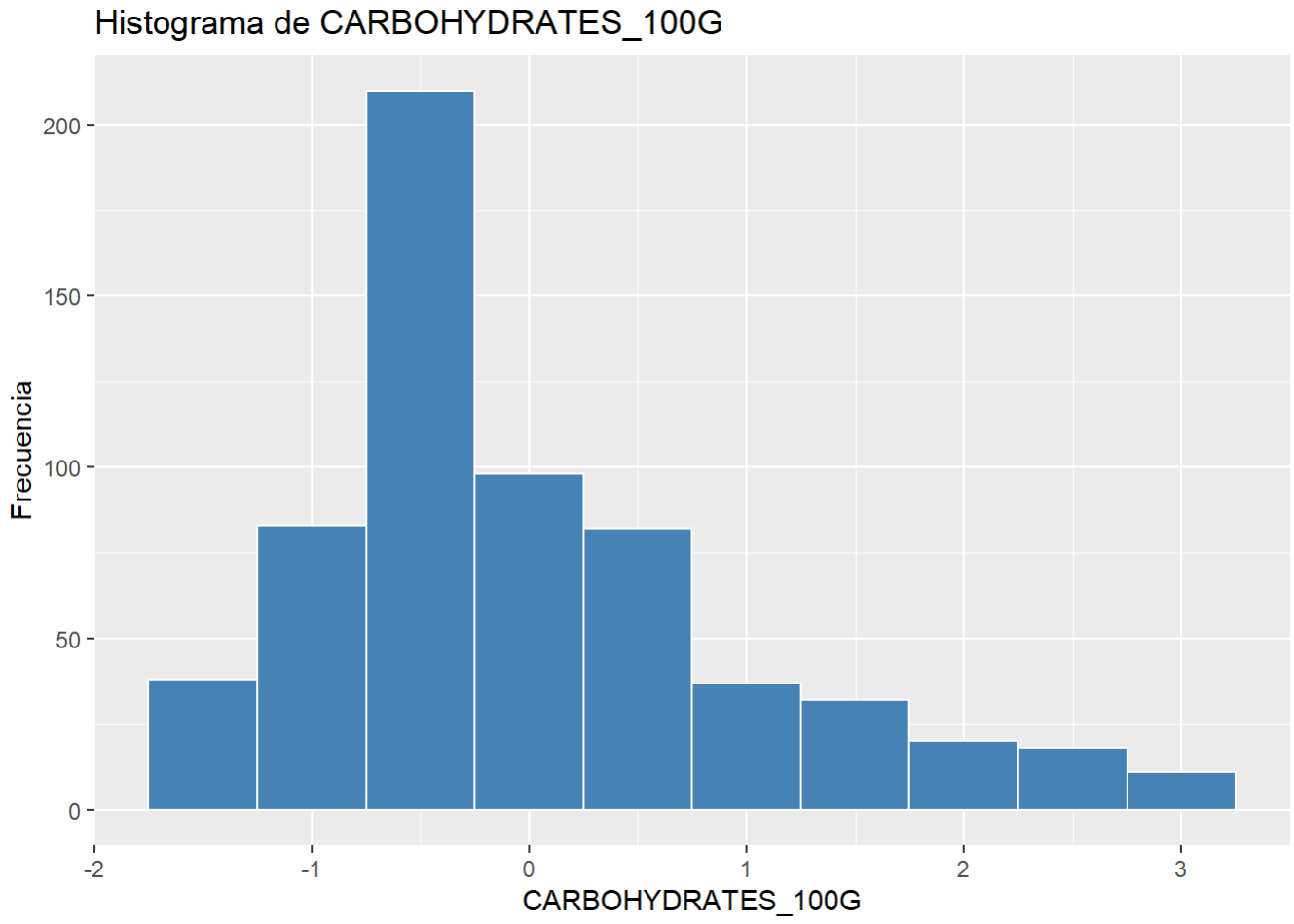

```
s_seitan <- scale(df_seitan[,-1])
s_seitan1 <- as.data.frame(s_seitan)
summary(s_seitan)
```

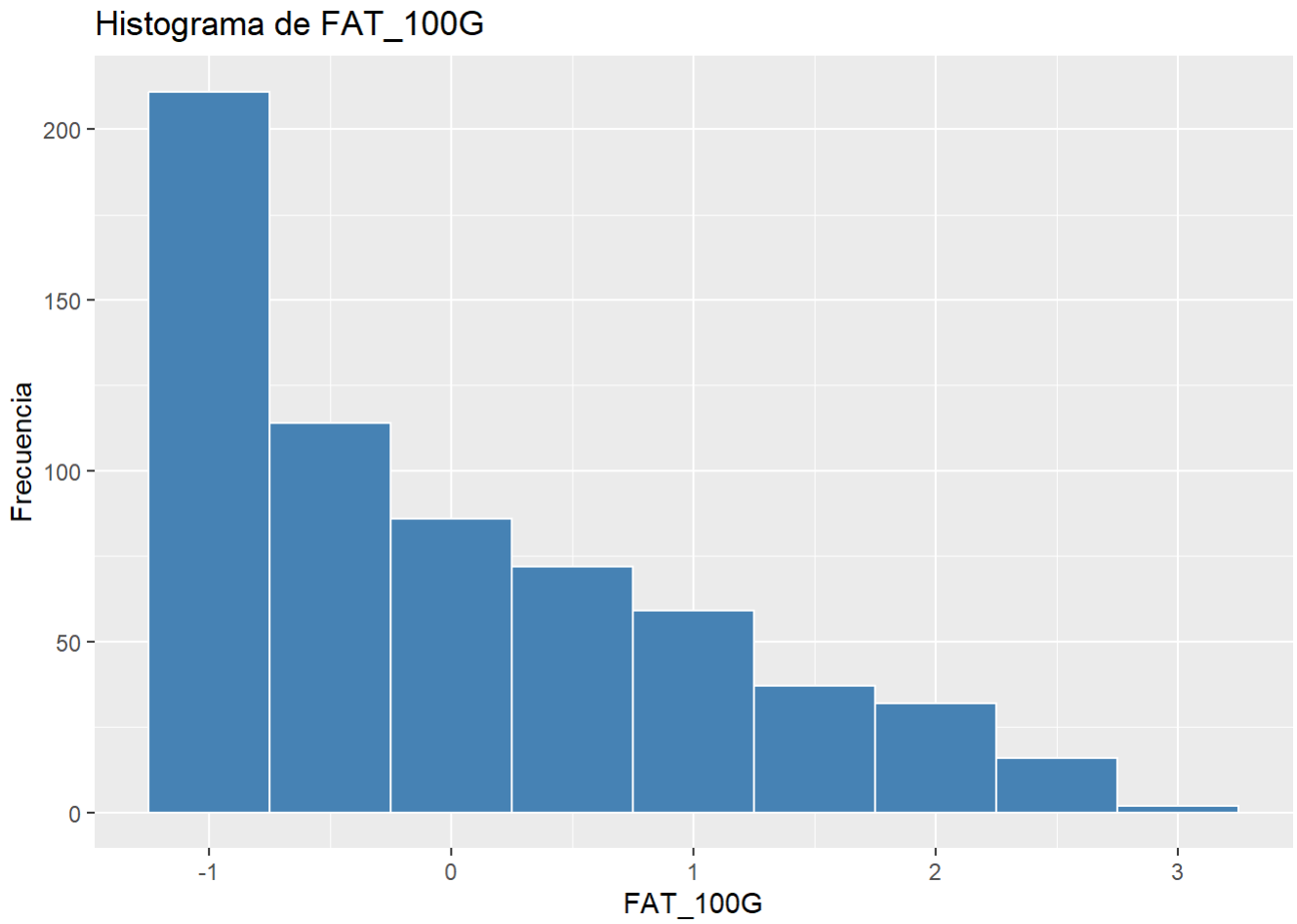
```
##  PROTEINS_100G     CARBOHYDRATES_100G    FAT_100G
##  Min.   :-2.7208   Min.   :-1.6559    Min.   :-1.1841
##  1st Qu.:-0.6028   1st Qu.:-0.6331    1st Qu.:-0.8193
##  Median : 0.0486   Median :-0.2790    Median :-0.3178
##  Mean   : 0.0000   Mean   : 0.0000    Mean   : 0.0000
##  3rd Qu.: 0.7029   3rd Qu.: 0.5078    3rd Qu.: 0.6397
##  Max.   : 2.2987   Max.   : 3.1436    Max.   : 2.7827
```

#Datos normalizados para el Seitán

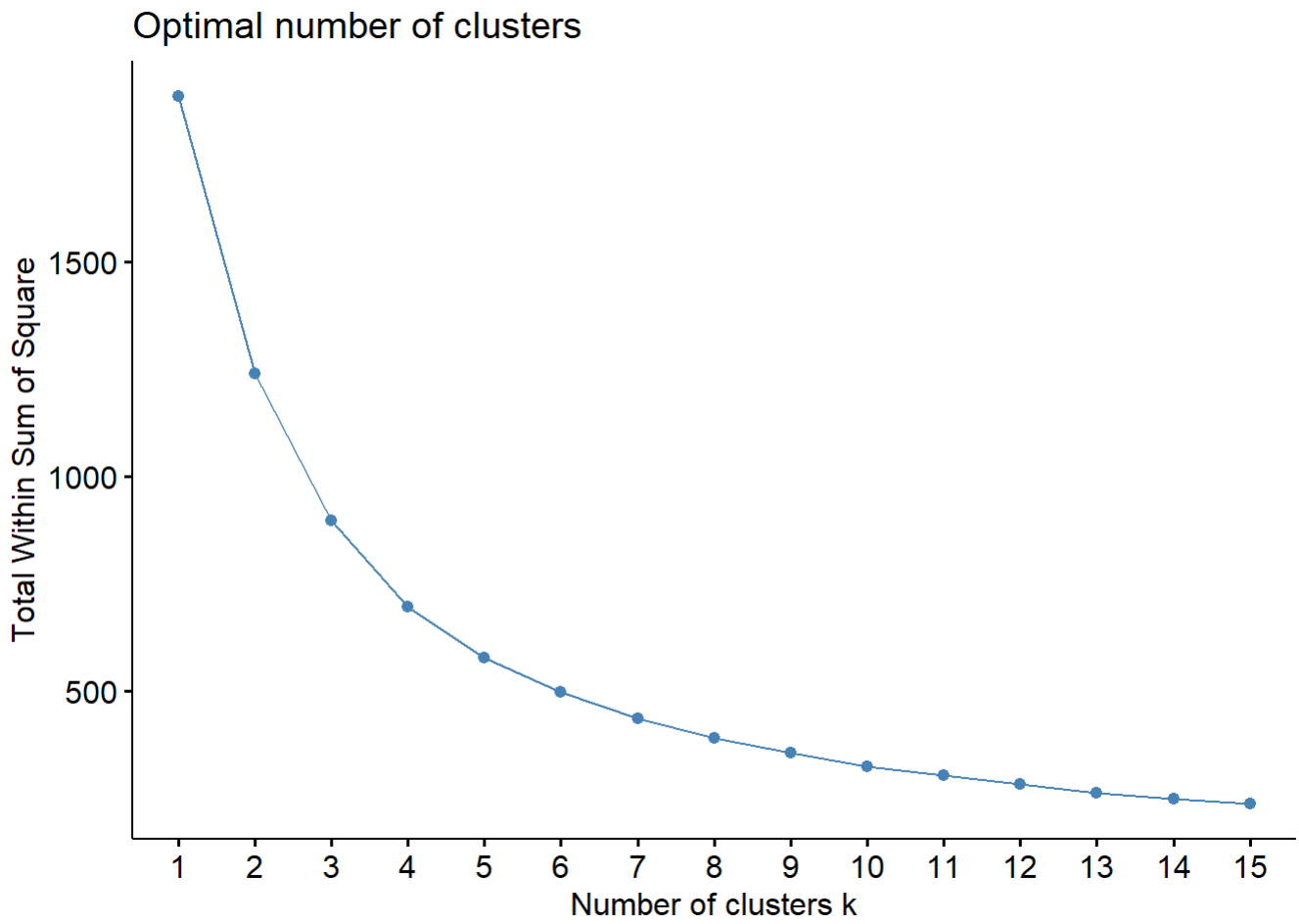
```r
# Obtener las columnas cuantitativas del dataframe
columnas_cuantitativas <- sapply(s_seitan1, is.numeric)

# Crear un histograma para cada columna cuantitativa
for (columna in names(s_seitan1[columnas_cuantitativas])) {
  plot_data <- s_seitan1[, columna]
  p <- ggplot(data.frame(x = plot_data), aes(x)) +
    geom_histogram(binwidth = 0.5, fill = "steelblue", color = "white") +
    labs(title = paste("Histograma de", columna),
         x = columna,
         y = "Frecuencia")

  print(p)
}
```


Histograma de PROTEINS_100G
Frecuencia
100
50
0
-3
-2
-1
0
1
2
3
PROTEINS_100G

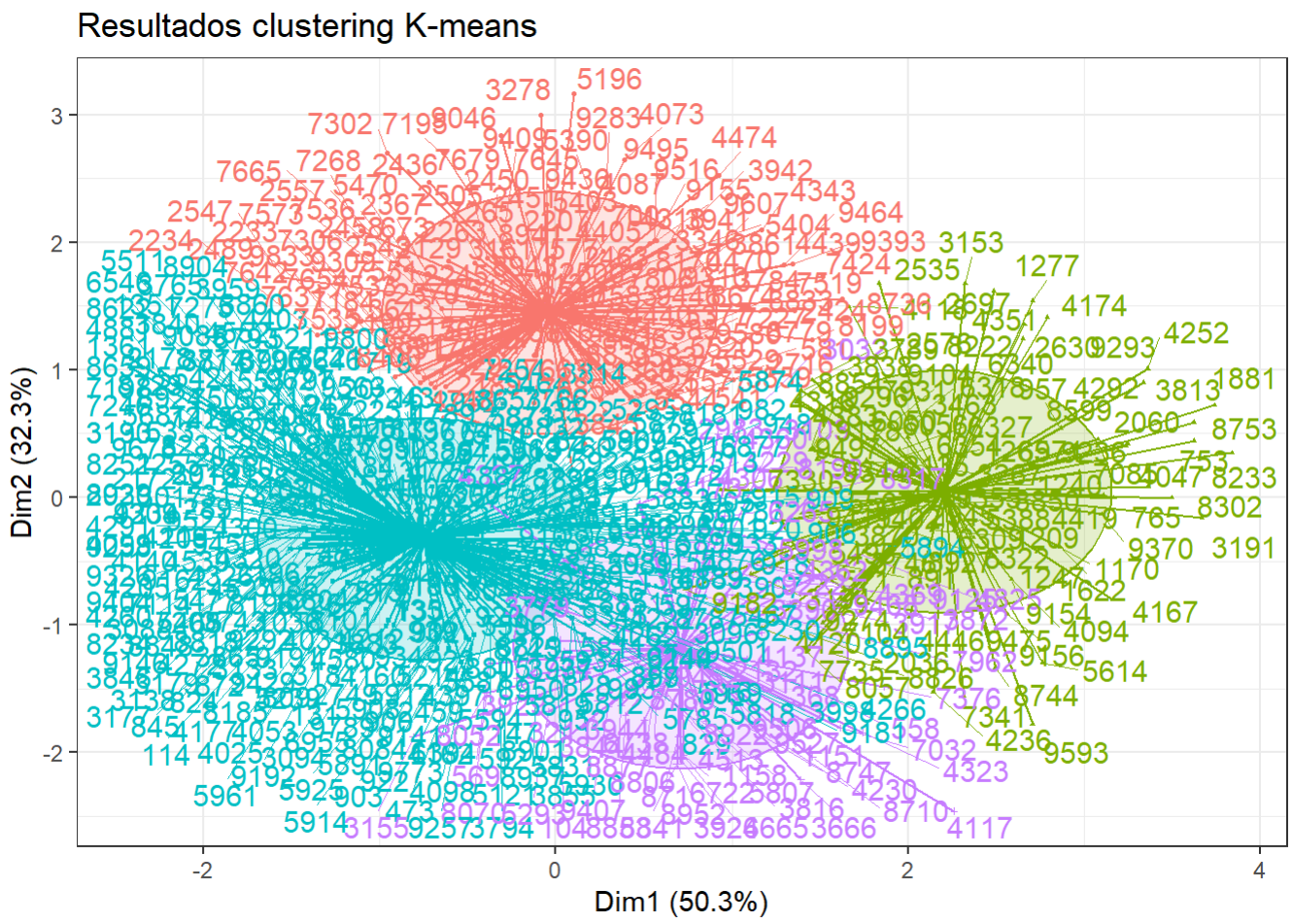

Histograma de CARBOHYDRATES_100G
Frecuencia
200
150
100
50
0
-2
-1
0
1
2
3
CARBOHYDRATES_100G



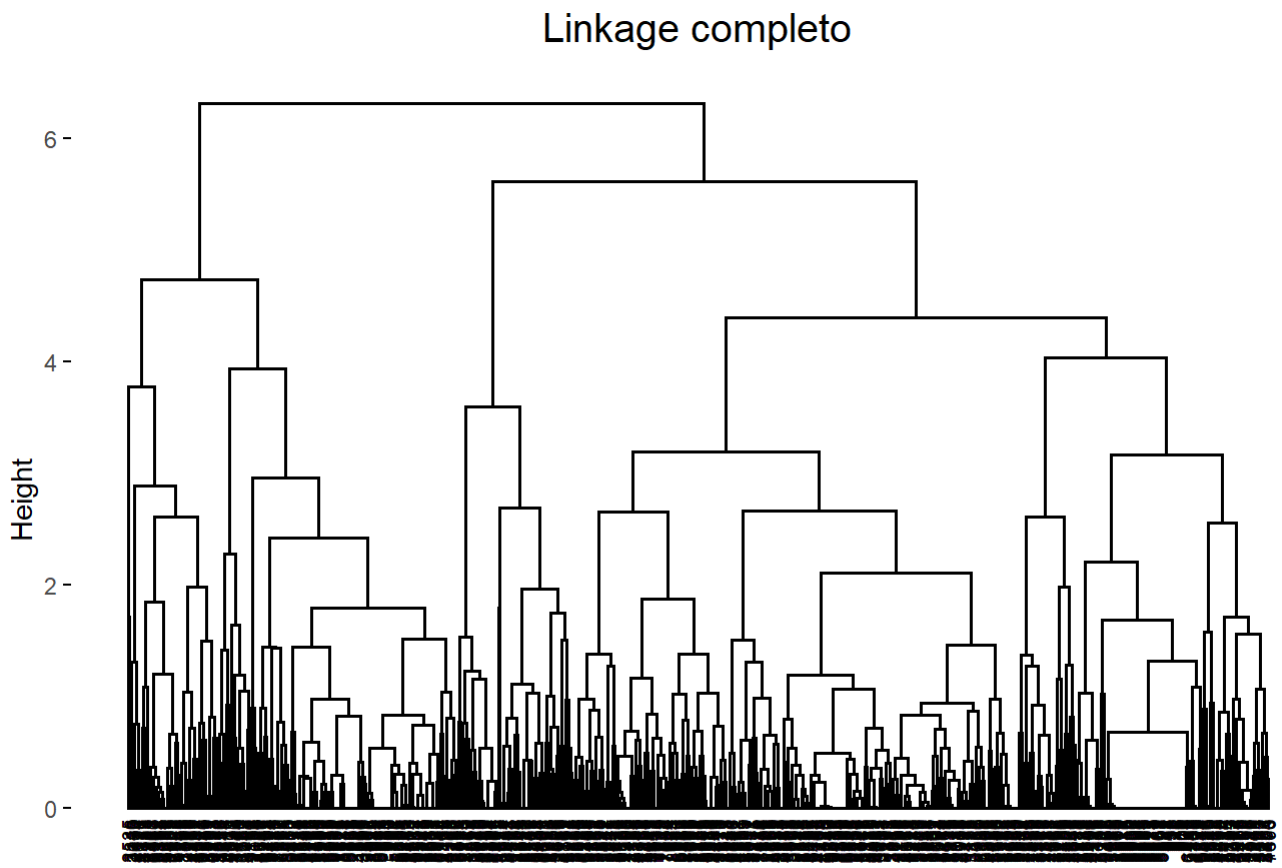

```
s_seitan <- scale(df_seitan[,-1])

# total de cluster óptimos
elbow <- fviz_nbclust(x = s_seitan, FUNcluster = kmeans, method = "wss", k.max = 15,
             diss = get_dist(s_seitan, method = "euclidean"), nstart = 25)
print(elbow)
```



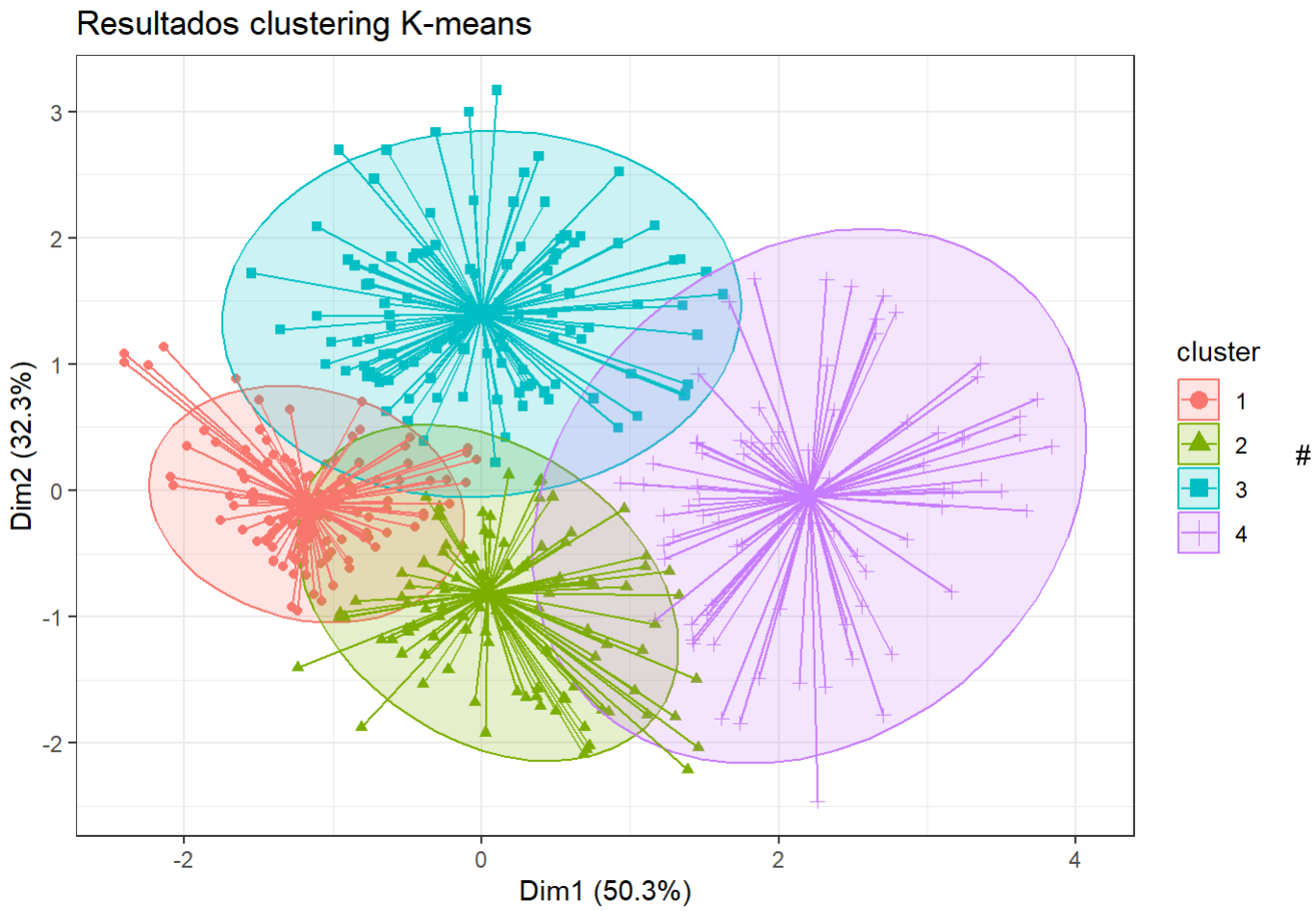

```
set.seed(123)
km_clusters <- kmeans(x=s_seitan,centers=4,nstart=25)
fviz_cluster(object=km_clusters,data=s_seitan,show.clust.cent = TRUE,
             ellipse.type="euclid",star.plot=TRUE,repel=TRUE,
             pointsize=0.5,outlier.color="darkred") +
  labs(title ="Resultados clustering K-means") +
  theme_bw() +
  theme(legend.position = "none")
```




```
set.seed(101)
heculidea <- hclust(d = dist(x = s_seitan, method = "euclidean"),
                    method = "complete")

fviz_dend(x=heculidea,cex=0.5,main = "Linkage completo",
               sub="Distancia euclídea")+
        theme(plot.title = element_text(hjust=0.5,size=15))
```

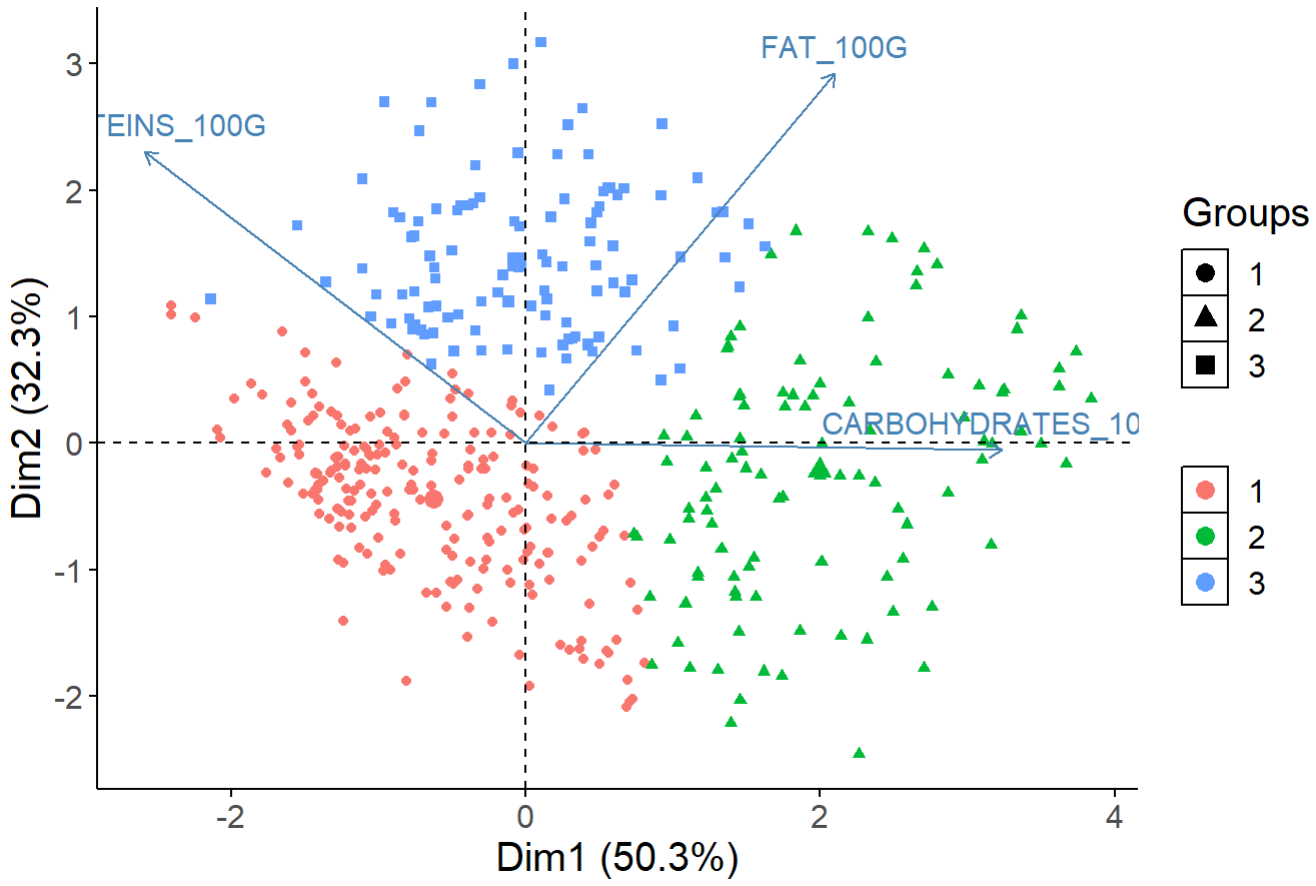



```
require(cluster)

pam.res <- pam(s_seitan, 4)
# Visualización
fviz_cluster(pam.res, geom = "point", ellipse.type = "norm",
             show.clust.cent = TRUE,star.plot = TRUE)+
  labs(title = "Resultados clustering K-means")+ theme_bw()
```



Biplot PCA y K-Means para medir representatividad seitan

```
# PCA
pca <- prcomp(df_seitan[,-1], scale=TRUE)
df_seitan.pca <- pca$x
# Cluster over the three first PCA dimensions
kc <- kmeans(df_seitan.pca[,1:3], 3)
fviz_pca_biplot(pca, label="var", habillage=as.factor(kc$cluster)) +
  labs(color=NULL) + ggtitle("") +
  theme(text = element_text(size = 15),
        panel.background = element_blank(),
        panel.grid.major = element_blank(),
        panel.grid.minor = element_blank(),
        axis.line = element_line(colour = "black"),
        legend.key = element_rect(fill = "white"))
```

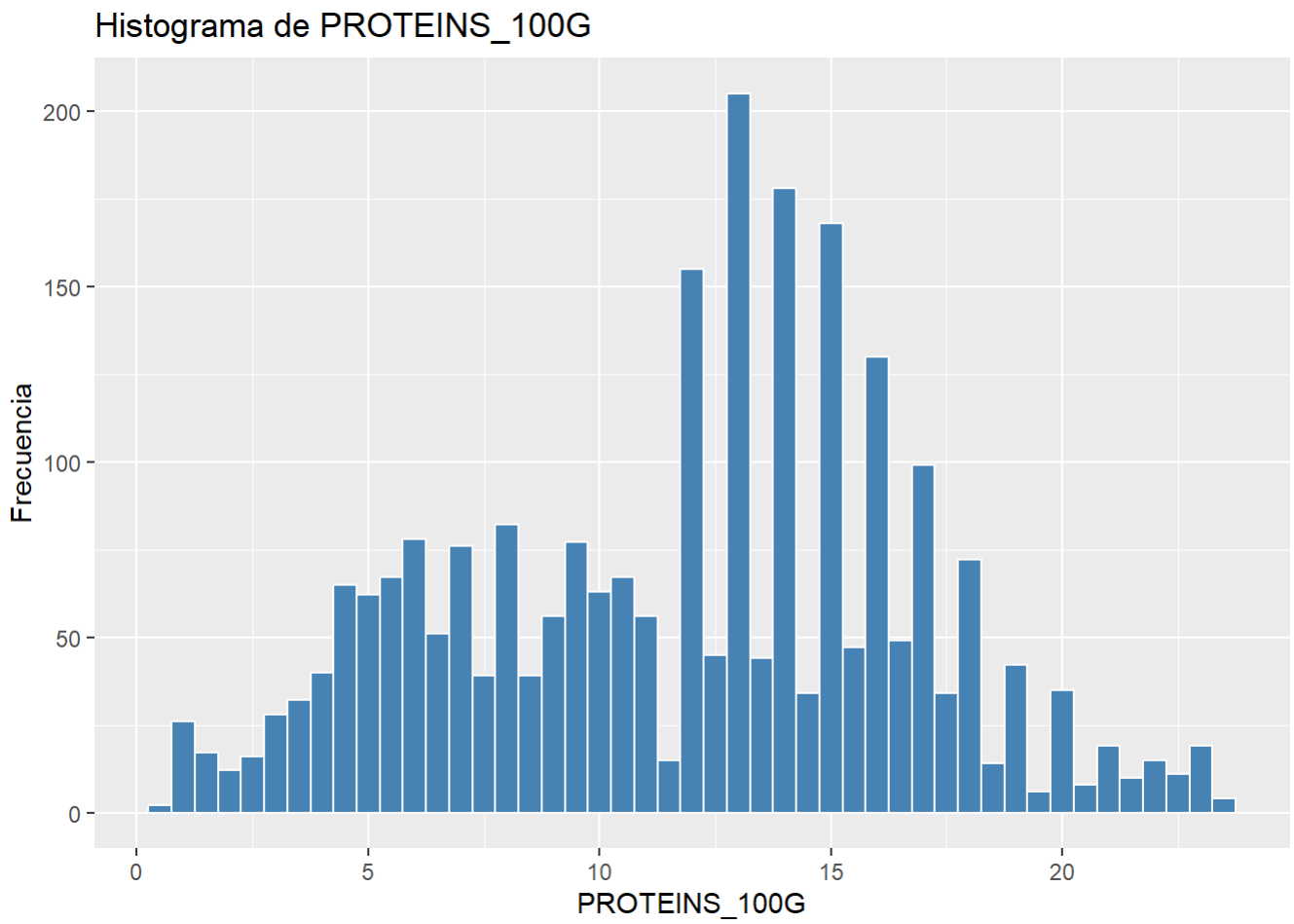


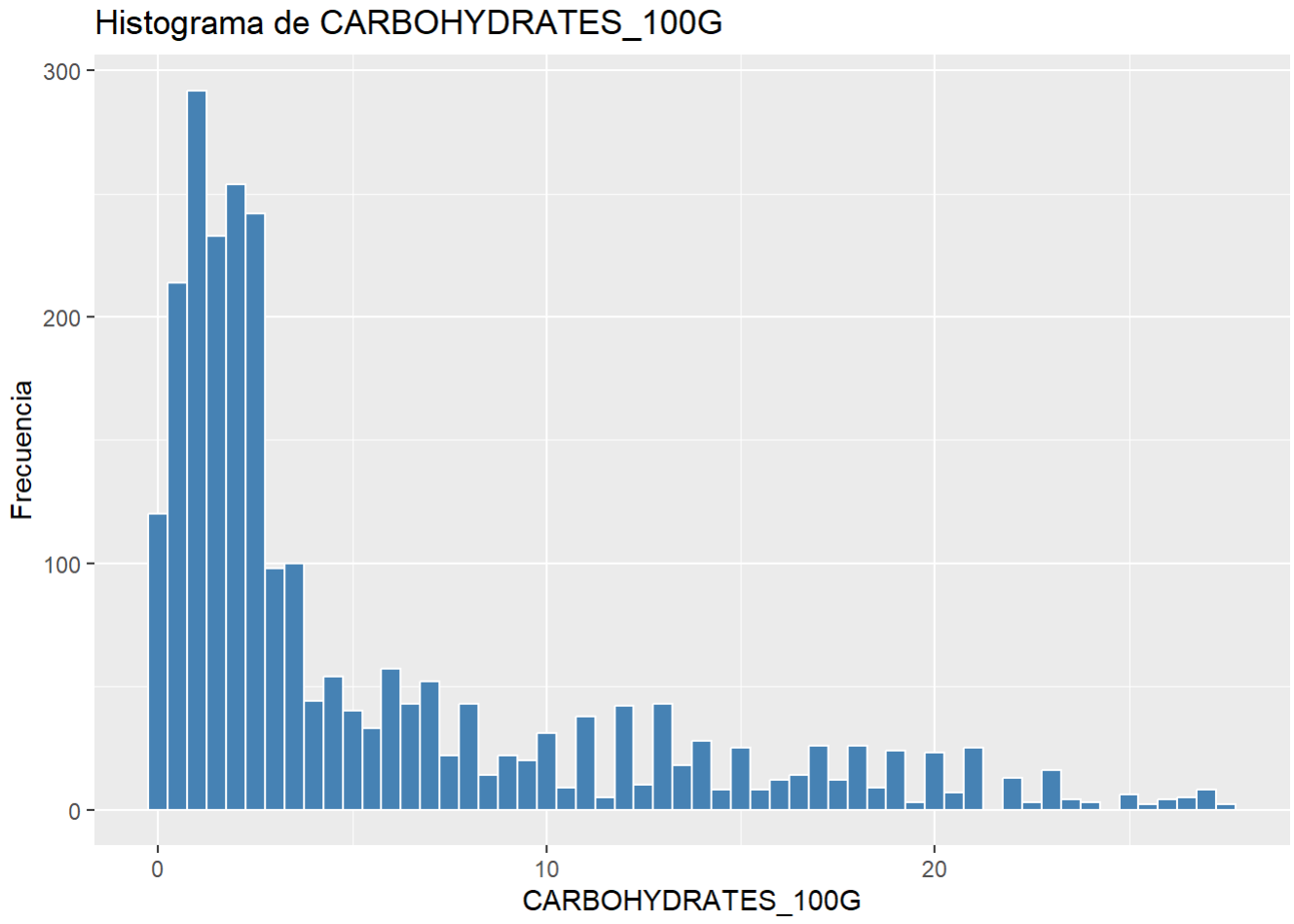
TOfu

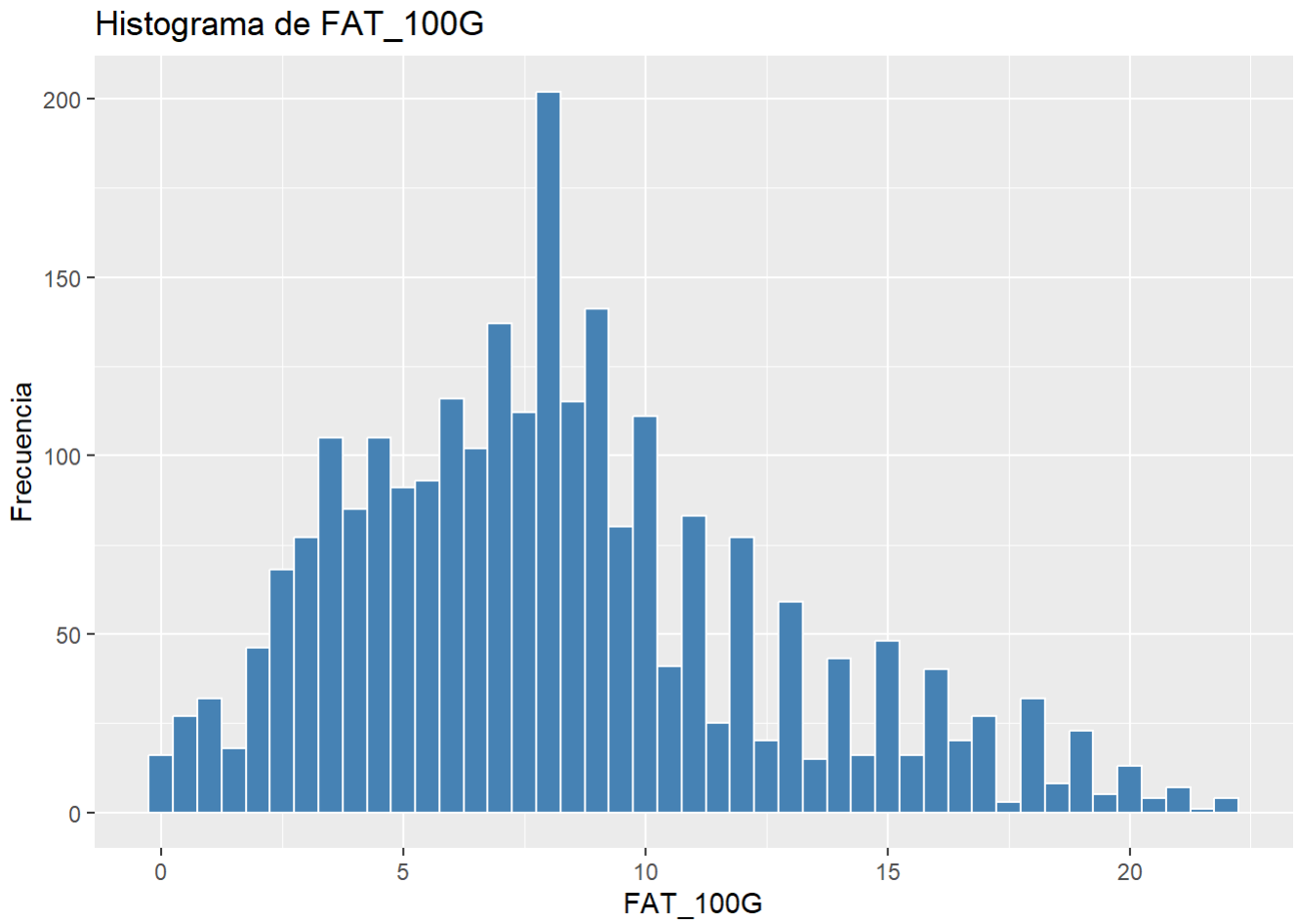
```
summary(df_tofu)
```

```
##  PRODUCT_NAME       PROTEINS_100G   CARBOHYDRATES_100G    FAT_100G
##  Length:2509        Min.   : 0.50   Min.   : 0.000     Min.   : 0.00
##  Class :character   1st Qu.: 7.90   1st Qu.: 1.300     1st Qu.: 5.00
##  Mode  :character   Median :12.60   Median : 2.400     Median : 7.80
##                     Mean   :11.78   Mean   : 5.414     Mean   : 8.18
##                     3rd Qu.:15.20   3rd Qu.: 7.500     3rd Qu.:10.30
##                     Max.   :23.60   Max.   :27.429     Max.   :21.80
```

```r
# Obtener las columnas cuantitativas del dataframe
columnas_cuantitativas <- sapply(df_tofu, is.numeric)

# Crear un histograma para cada columna cuantitativa
for (columna in names(df_tofu[columnas_cuantitativas])) {
  plot_data <- df_tofu[, columna]
  p <- ggplot(data.frame(x = plot_data), aes(x)) +
    geom_histogram(binwidth = 0.5, fill = "steelblue", color = "white") +
    labs(title = paste("Histograma de", columna),
         x = columna,
         y = "Frecuencia")

  print(p)
}
```


Histograma de PROTEINS_100G
Frecuencia
200
150
100
50
0
0
5
10
15
20
PROTEINS_100G


Histograma de CARBOHYDRATES_100G
Frecuencia
300
200
100
0
0
10
20
CARBOHYDRATES_100G

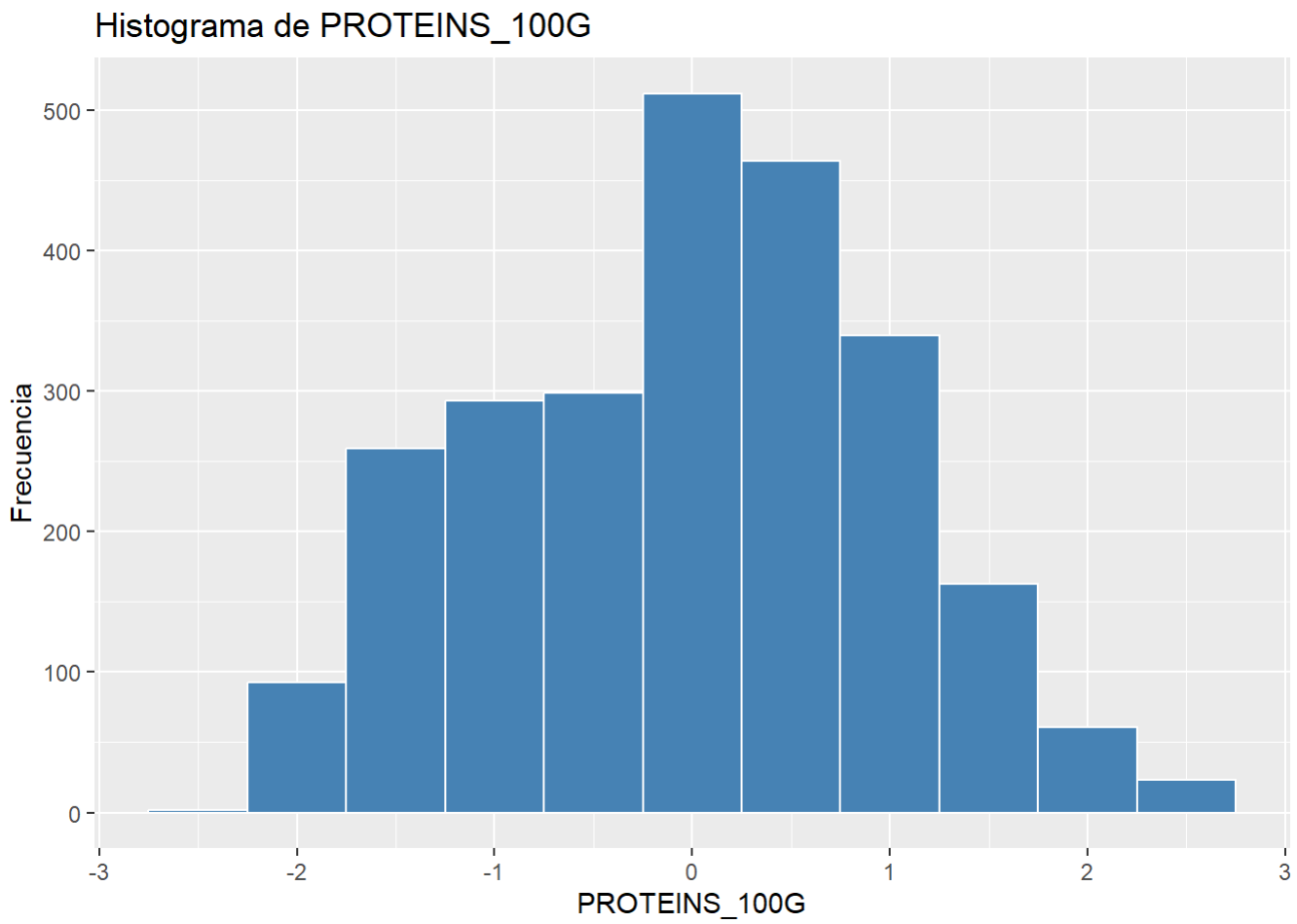


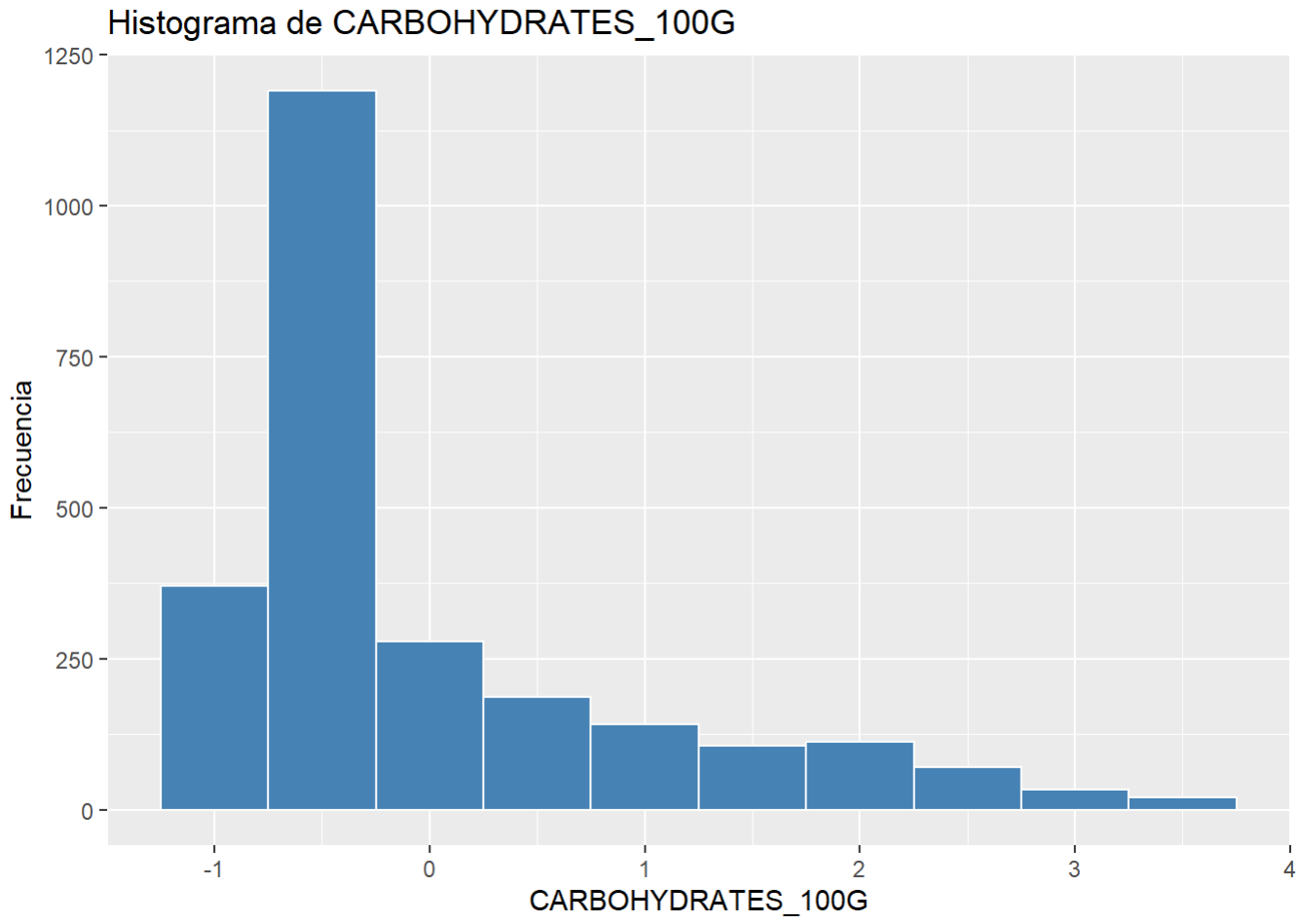

```
s_tofu <- scale(df_tofu[,-1])
s_tofu1 <- as.data.frame(s_tofu)
summary(s_tofu)
```

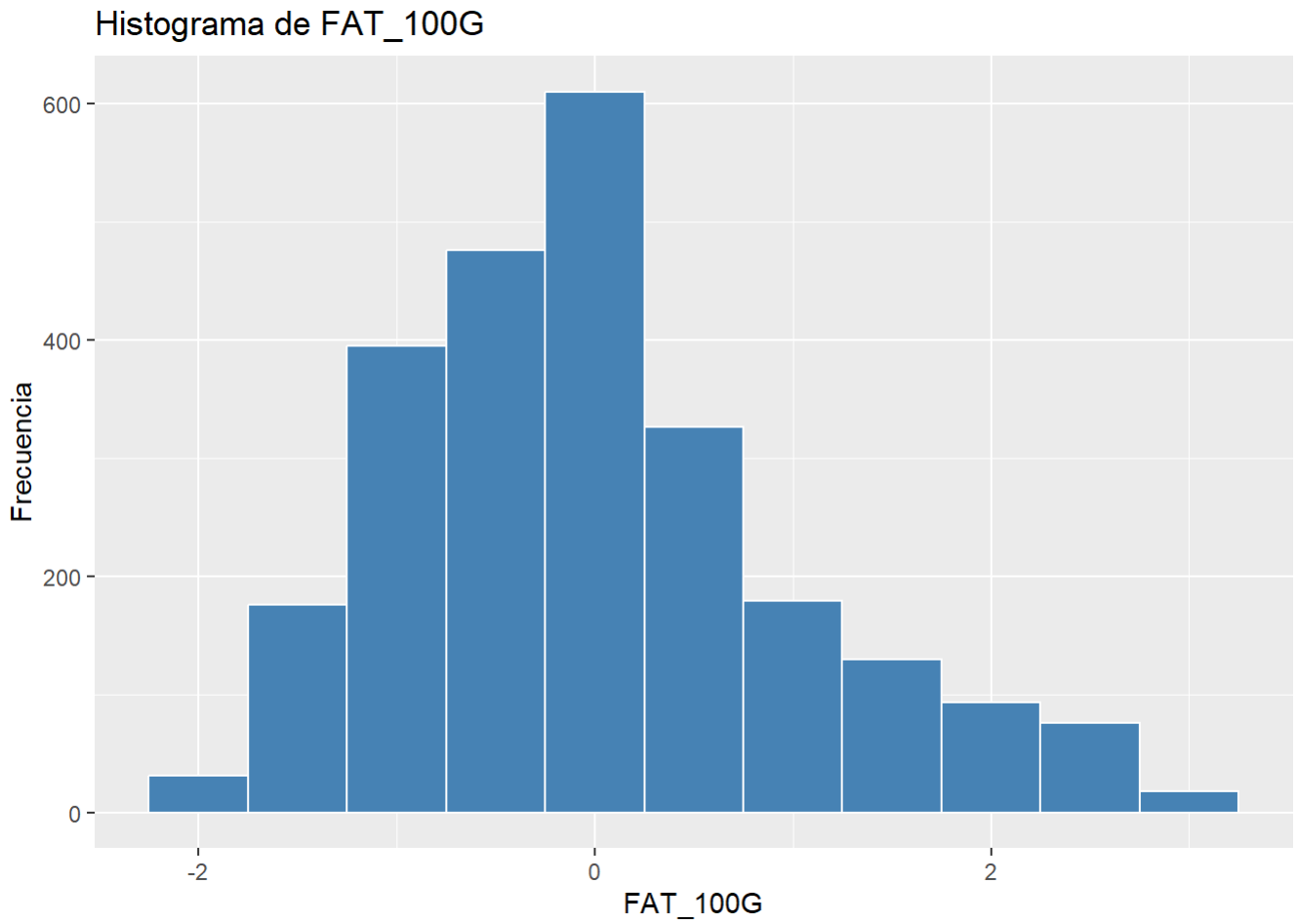
```
##  PROTEINS_100G     CARBOHYDRATES_100G    FAT_100G
##  Min.   :-2.2874   Min.   :-0.8833    Min.   :-1.88626
##  1st Qu.:-0.7870   1st Qu.:-0.6712    1st Qu.:-0.73328
##  Median : 0.1660   Median :-0.4918    Median :-0.08761
##  Mean   : 0.0000   Mean   : 0.0000    Mean   : 0.00000
##  3rd Qu.: 0.6932   3rd Qu.: 0.3402    3rd Qu.: 0.48888
##  Max.   : 2.3964   Max.   : 3.5914    Max.   : 3.14074
```

#Datos normalizados para el Tofu

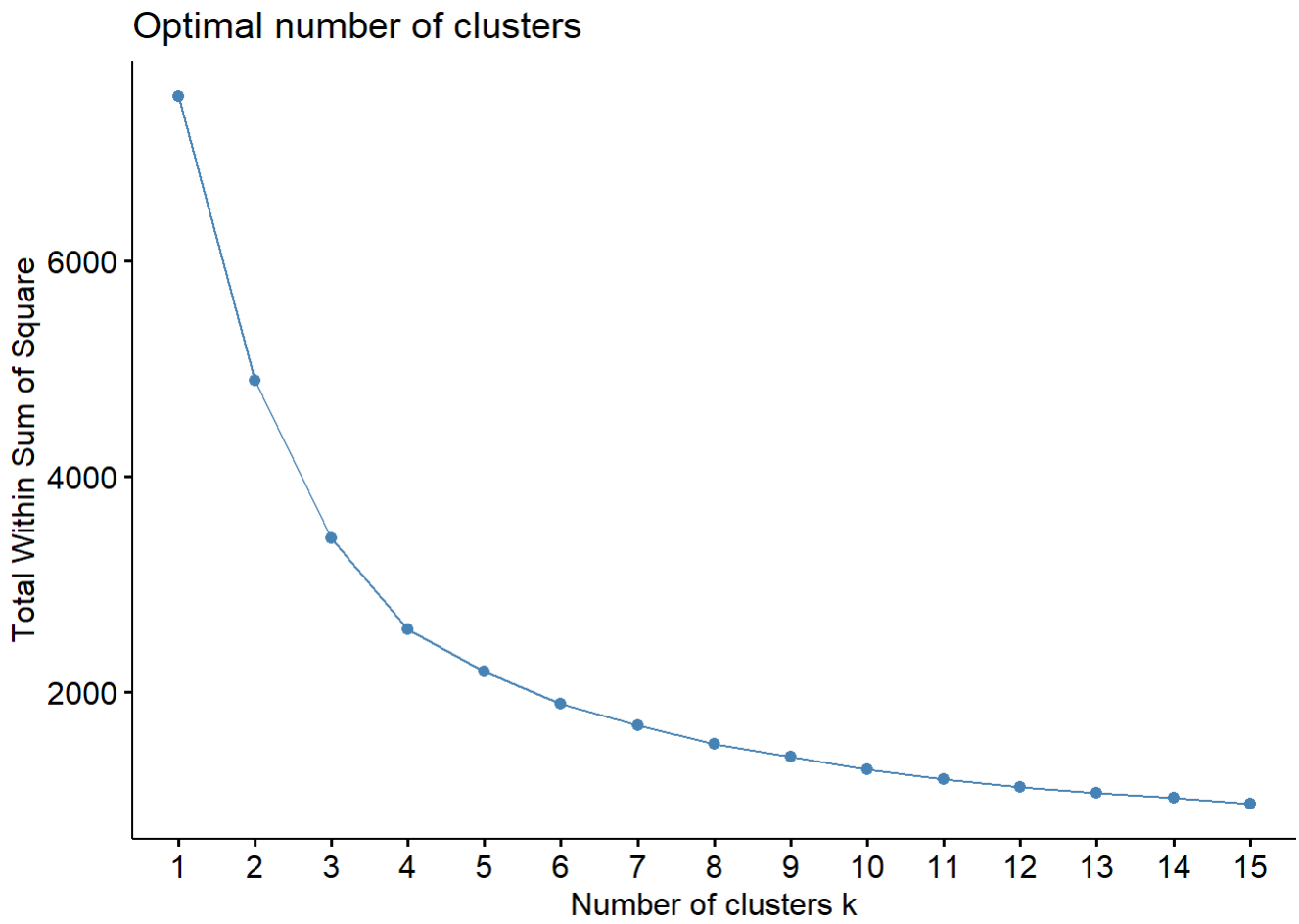
```
# Obtener las columnas cuantitativas del dataframe
columnas_cuantitativas <- sapply(s_tofu1, is.numeric)

# Crear un histograma para cada columna cuantitativa
for (columna in names(s_tofu1[columnas_cuantitativas])) {
  plot_data <- s_tofu1[, columna]
  p <- ggplot(data.frame(x = plot_data), aes(x)) +
    geom_histogram(binwidth = 0.5, fill = "steelblue", color = "white") +
    labs(title = paste("Histograma de", columna),
         x = columna,
         y = "Frecuencia")

  print(p)
}
```


Histograma de PROTEINS_100G
Frecuencia
500
400
300
200
100
0
-3
-2
-1
0
1
2
3
PROTEINS_100G

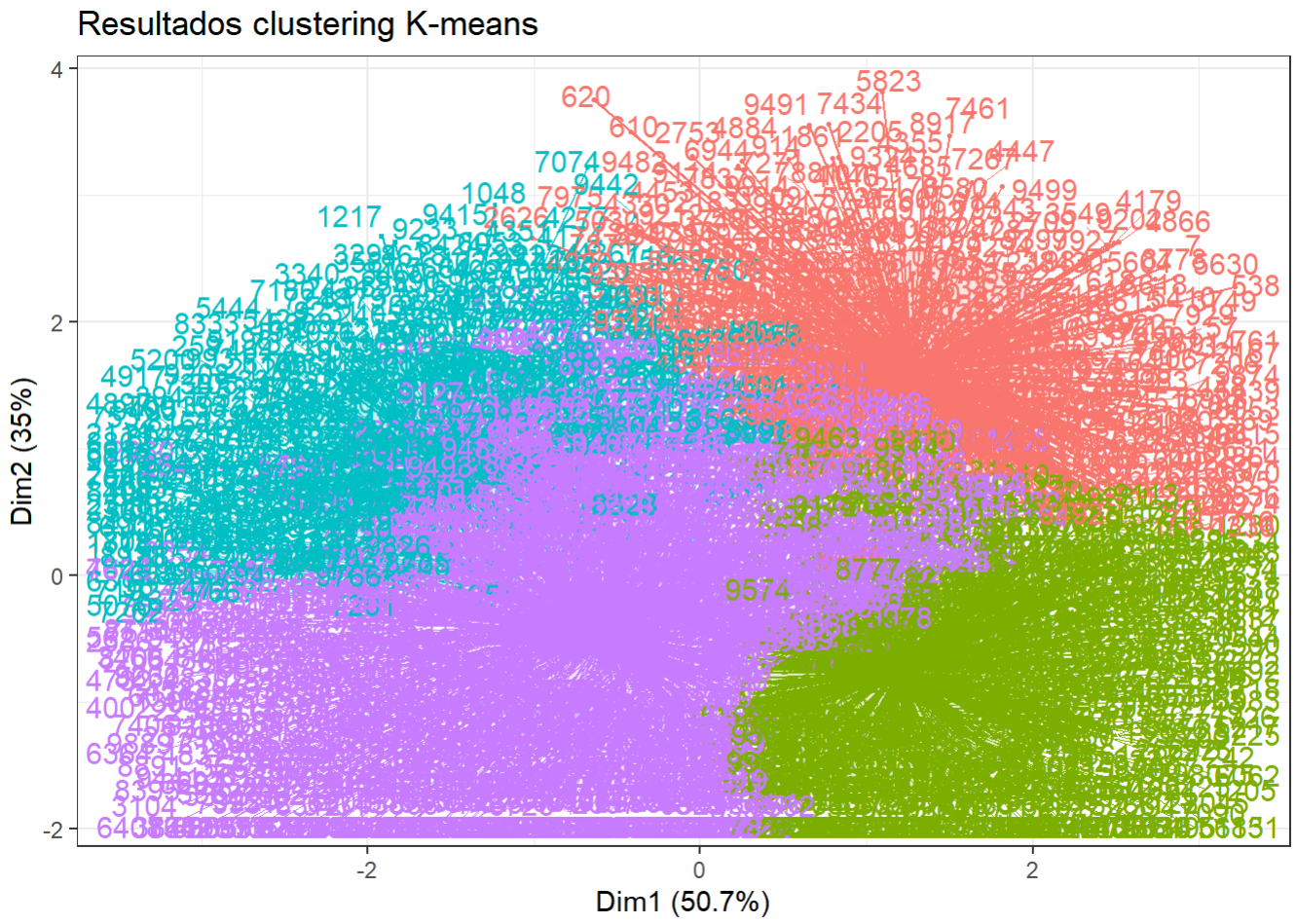

Histograma de CARBOHYDRATES_100G
Frecuencia
1250
1000
750
500
250
0
-1
0
1
2
3
4
CARBOHYDRATES_100G



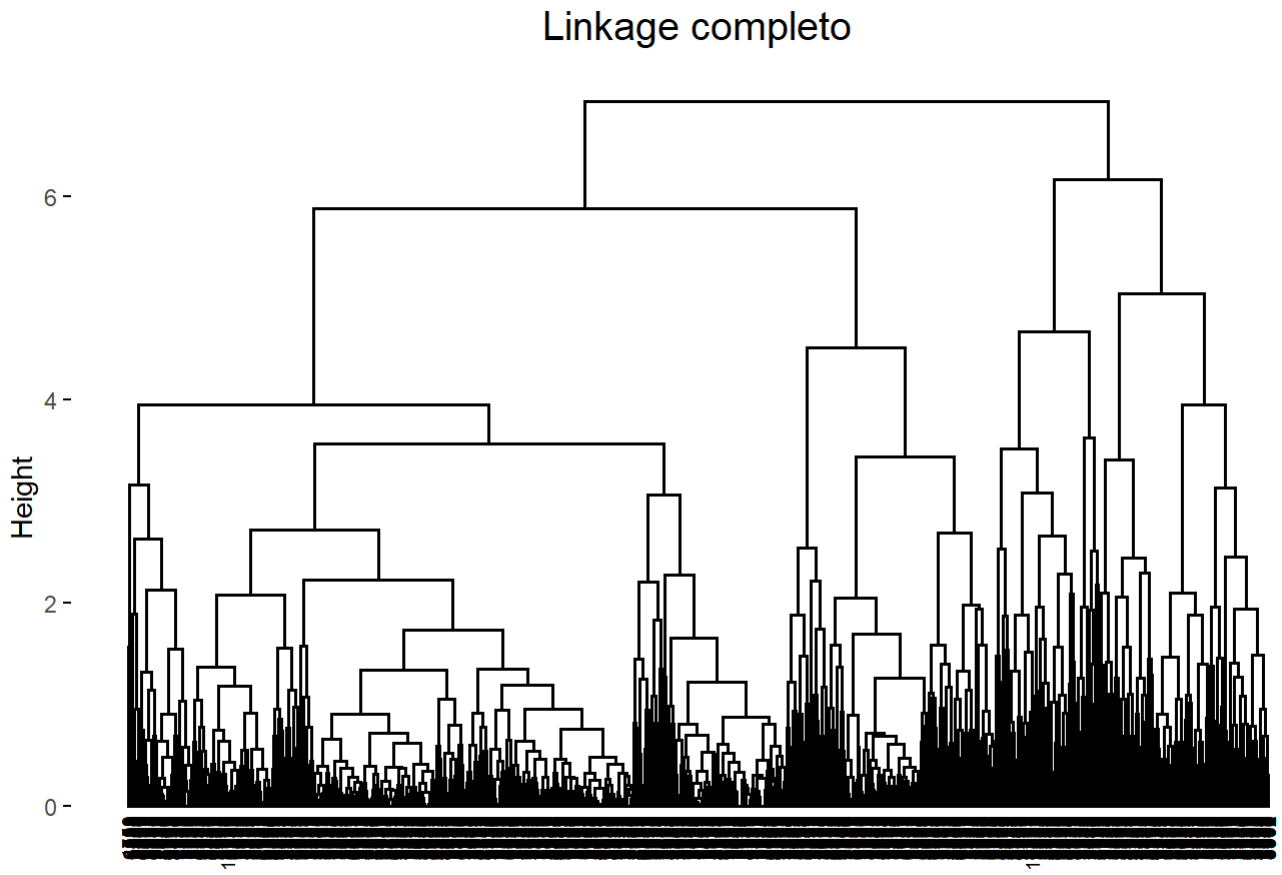

```
s_tofu <- scale(df_tofu[,-1])

# total de cluster óptimos
elbow <- fviz_nbclust(x = s_tofu, FUNcluster = kmeans, method = "wss", k.max = 15,
             diss = get_dist(s_tofu, method = "euclidean"), nstart = 25)
print(elbow)
```



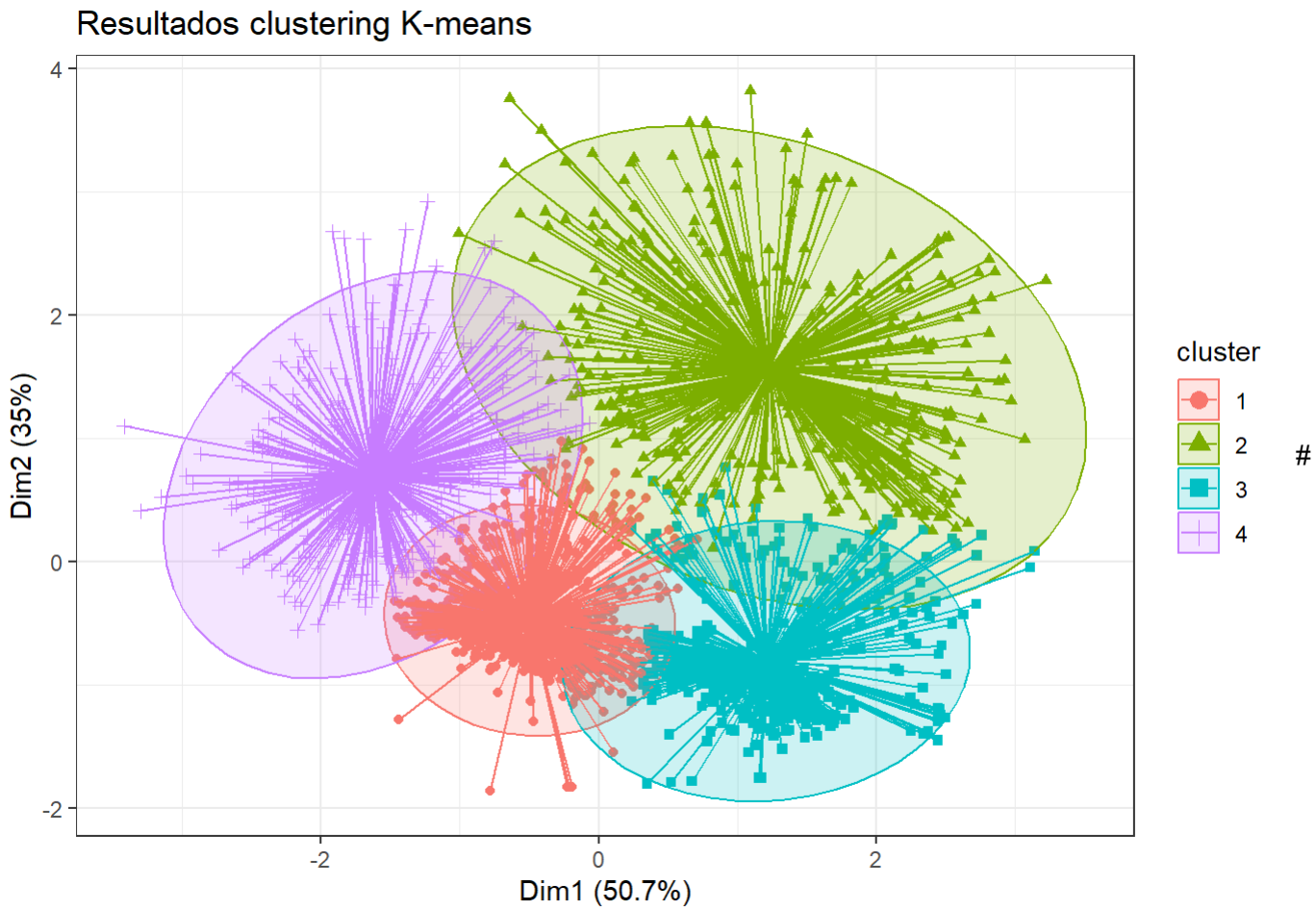

```
set.seed(123)
km_clusters <- kmeans(x=s_tofu,centers=4,nstart=25)
fviz_cluster(object=km_clusters,data=s_tofu,show.clust.cent = TRUE,
             ellipse.type="euclid",star.plot=TRUE,repel=TRUE,
             pointsize=0.5,outlier.color="darkred") +
  labs(title ="Resultados clustering K-means") +
  theme_bw() +
  theme(legend.position = "none")
```




```
set.seed(101)
heculidea <- hclust(d = dist(x = s_tofu, method = "euclidean"),
                    method = "complete")

fviz_dend(x=heculidea,cex=0.5,main = "Linkage completo",
               sub="Distancia euclídea")+
        theme(plot.title = element_text(hjust=0.5,size=15))
```

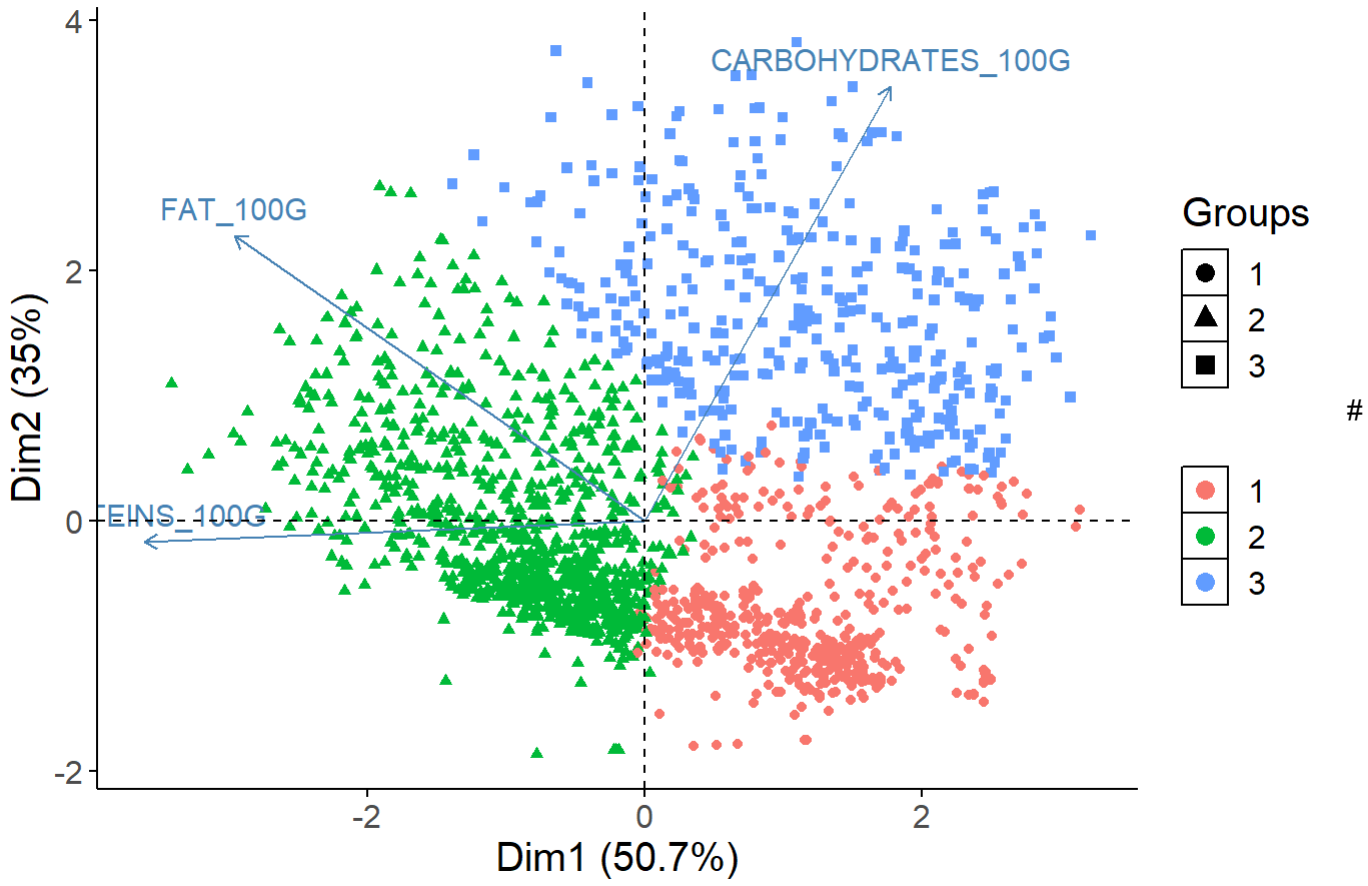



```
require(cluster)

pam.res <- pam(s_tofu, 4)
# Visualización
fviz_cluster(pam.res, geom = "point", ellipse.type = "norm",
             show.clust.cent = TRUE,star.plot = TRUE)+
  labs(title = "Resultados clustering K-means")+ theme_bw()
```



Biplot PCA y K-Means para medir representatividad tofu

```
# PCA
pca <- prcomp(df_tofu[,-1], scale=TRUE)
df_tofu.pca <- pca$x
# Cluster over the three first PCA dimensions
kc <- kmeans(df_tofu.pca[,1:3], 3)
fviz_pca_biplot(pca, label="var", habillage=as.factor(kc$cluster)) +
  labs(color=NULL) + ggtitle("") +
  theme(text = element_text(size = 15),
        panel.background = element_blank(),
        panel.grid.major = element_blank(),
        panel.grid.minor = element_blank(),
        axis.line = element_line(colour = "black"),
        legend.key = element_rect(fill = "white"))
```



Método no jerárquico CLARA basado en simulación y muestreo

Soja

```
clara_clusters <- clara(x = scale(df_soja[,-1]), k = 4, metric = "manhattan", stand = TRUE,
                        samples = 60, pamLike = TRUE)
clara_clusters$sample
```

```
##  [1] "1013"  "1032"  "1345"  "1576"  "1597"  "1737"  "1796"  "1830"  "1884"
## [10] "2161"  "2345"  "2446"  "2490"  "2513"  "2911"  "3002"  "3544"  "3598"
## [19] "3635"  "3991"  "4055"  "4178"  "4223"  "4297"  "4299"  "4402"  "4698"
## [28] "5522"  "5835"  "6028"  "6136"  "6174"  "6424"  "6493"  "6578"  "6884"
## [37] "6978"  "7006"  "7525"  "7552"  "7633"  "7672"  "8437"  "8631"  "8671"
## [46] "9004"  "9397"  "10003"
```

```
clara_clusters$medoids
```

```
##      PROTEINS_100G CARBOHYDRATES_100G    FAT_100G
## 8671    -0.1011949          1.8234211  0.76401714
## 4178     0.1431987         -0.5813796  0.55109662
## 1345    -0.6782355         -0.3889956 -0.69803713
## 7552     2.3834738          0.3805407  0.06847676
```

```
clara_clusters$i.med
```

```
## [1] 1991  963  248 1771
```

```
clara_clusters$clustering
```

```
##    11    23    24    26    28    37    39    56    90   188   223   253   294
##     1     1     2     2     3     3     2     3     3     1     3     3     3
##   295   298   308   317   332   339   345   348   352   364   365   372   374
##     1     4     3     1     2     2     3     3     3     3     4     2     2
##   375   377   379   380   384   386   389   401   404   405   408   411   419
##     3     1     3     2     3     3     3     3     4     2     2     3     3
##   422   433   440   449   450   476   479   480   485   507   540   552   570
##     3     4     3     1     3     3     3     3     4     3     4     3     3
##   574   585   647   659   663   667   669   677   681   683   704   709   714
##     2     1     1     2     4     2     3     3     3     4     2     1     3
##   728   729   732   737   743   744   751   762   763   767   771   778   779
##     2     2     2     2     2     2     3     2     3     3     2     4     3
##   780   783   786   790   796   799   803   805   823   825   833   843   847
##     2     3     2     3     2     4     3     3     1     3     3     3     3
##   849   851   854   873   880   882   892   897   932   935   944   959   962
##     2     2     1     3     3     3     2     2     4     3     3     3     2
##   965   966   967   968   978   987   991   992   994   995   999  1000  1001
##     2     3     3     2     3     2     3     2     3     2     3     2     1
##  1008  1009  1010  1012  1013  1014  1018  1019  1023  1024  1025  1026  1029
##     1     2     2     2     1     3     3     3     2     2     2     2     2
##  1030  1032  1035  1037  1040  1041  1042  1047  1049  1054  1057  1058  1060
##     3     3     3     3     3     3     3     2     2     3     3     1     2
##  1062  1064  1066  1068  1072  1073  1074  1078  1079  1080  1081  1086  1089
##     2     2     3     1     3     2     2     2     3     3     2     3     2
##  1091  1092  1094  1095  1101  1103  1105  1110  1116  1117  1118  1122  1124
##     2     3     1     2     2     3     3     2     3     1     3     3     3
##  1129  1130  1131  1132  1134  1135  1136  1140  1141  1146  1147  1148  1153
##     3     2     1     1     2     3     2     3     2     2     1     3     3
##  1160  1165  1169  1172  1173  1175  1176  1179  1181  1184  1185  1186  1187
##     2     2     3     3     3     2     2     2     1     1     2     3     3
##  1188  1189  1192  1193  1197  1200  1208  1212  1214  1216  1219  1220  1227
##     2     2     2     3     3     3     3     3     3     3     2     3     3
##  1232  1233  1234  1238  1243  1245  1249  1250  1251  1252  1254  1256  1261
##     4     3     2     3     2     3     3     3     1     2     3     3     2
##  1264  1267  1268  1271  1272  1276  1281  1284  1285  1286  1294  1302  1307
##     2     2     2     2     1     3     1     3     3     3     3     3     3
##  1312  1315  1316  1318  1327  1328  1331  1333  1337  1338  1339  1342  1344
##     2     3     2     2     3     3     3     3     2     4     3     3     2
##  1345  1346  1348  1350  1354  1355  1356  1357  1364  1366  1367  1369  1374
##     3     2     3     2     3     3     3     3     3     3     3     3     3
##  1375  1376  1377  1378  1379  1381  1384  1385  1388  1390  1392  1393  1395
##     3     3     3     3     3     2     3     2     2     3     1     3     2
##  1396  1398  1400  1401  1402  1403  1404  1405  1406  1409  1410  1411  1414
##     3     2     3     3     3     3     3     4     3     3     2     3     3
##  1415  1417  1418  1419  1422  1423  1430  1432  1433  1435  1436  1438  1440
##     3     3     3     3     1     3     2     3     3     3     3     3     3
##  1441  1442  1444  1449  1452  1454  1455  1456  1458  1459  1460  1462  1464
##     2     3     3     3     3     1     2     3     2     3     3     3     3
##  1465  1467  1470  1471  1472  1473  1474  1476  1477  1481  1482  1484  1486
##     3     3     3     3     3     3     2     3     3     3     2     2     3
##  1487  1489  1490  1492  1494  1495  1497  1498  1500  1502  1504  1505  1507
##     3     3     3     3     2     2     3     3     2     1     3     3     1
```

```
##  1508  1510  1515  1516  1517  1523  1525  1526  1527  1528  1529  1530  1533
##     3     2     4     3     2     3     3     3     1     3     3     3     1
##  1535  1536  1537  1540  1543  1547  1548  1549  1551  1557  1558  1559  1560
##     1     2     3     3     1     3     3     4     3     3     3     3     2
##  1562  1564  1566  1567  1568  1570  1575  1576  1585  1588  1592  1593  1596
##     1     4     3     4     1     4     3     2     2     2     4     4     4
##  1597  1601  1608  1609  1620  1623  1624  1626  1629  1630  1631  1635  1640
##     3     4     2     3     4     2     4     2     2     4     1     3     3
##  1642  1645  1649  1650  1656  1659  1662  1666  1667  1669  1674  1677  1679
##     3     3     3     1     3     2     3     1     3     1     3     3     3
##  1680  1683  1684  1685  1688  1690  1691  1696  1698  1699  1700  1701  1708
##     2     2     2     2     2     3     2     3     1     2     3     3     3
##  1709  1711  1712  1713  1714  1721  1722  1723  1725  1726  1727  1728  1729
##     2     2     3     3     1     2     2     3     3     3     3     2     2
##  1734  1737  1741  1743  1746  1749  1751  1752  1758  1760  1761  1763  1778
##     3     1     2     3     1     3     1     3     3     2     3     2     2
##  1781  1782  1790  1793  1794  1796  1797  1801  1805  1810  1812  1814  1815
##     2     1     3     2     3     2     2     2     3     3     3     1     2
##  1816  1817  1818  1821  1823  1827  1828  1830  1831  1833  1836  1839  1845
##     3     3     1     2     3     3     3     3     2     3     3     3     2
##  1849  1853  1855  1857  1869  1873  1875  1876  1877  1878  1884  1885  1889
##     3     1     2     4     4     3     1     3     3     2     3     3     2
##  1892  1893  1898  1904  1907  1911  1916  1927  1928  1931  1940  1945  1948
##     3     3     2     3     1     3     3     1     1     2     1     1     1
##  1953  1962  1965  1966  1978  1988  1989  1990  1998  2003  2006  2009  2010
##     1     4     1     1     2     3     2     4     4     4     4     4     4
##  2011  2015  2019  2022  2024  2026  2033  2035  2037  2040  2041  2047  2048
##     2     4     4     1     4     1     4     1     4     1     4     4     4
##  2053  2055  2057  2058  2061  2062  2070  2075  2077  2085  2088  2093  2097
##     4     2     3     4     3     4     3     1     2     3     4     3     3
##  2099  2100  2103  2105  2106  2109  2119  2131  2133  2141  2143  2158  2161
##     4     3     4     2     2     3     2     2     4     3     3     3     2
##  2162  2165  2175  2177  2181  2182  2184  2193  2203  2204  2211  2219  2220
##     4     3     3     1     3     1     4     2     4     2     4     3     2
##  2223  2239  2242  2252  2261  2266  2268  2269  2271  2273  2274  2275  2277
##     2     3     3     3     3     2     4     2     3     3     4     2     3
##  2279  2288  2292  2294  2299  2300  2307  2312  2316  2320  2324  2325  2326
##     3     2     3     1     2     3     2     3     3     3     3     4     3
##  2328  2334  2335  2338  2344  2345  2350  2354  2360  2361  2363  2366  2370
##     3     1     2     4     3     4     4     2     2     4     2     4     3
##  2371  2373  2374  2384  2385  2386  2391  2392  2396  2398  2400  2409  2413
##     3     3     4     4     3     4     2     4     4     4     3     3     4
##  2422  2427  2429  2432  2437  2446  2452  2455  2457  2460  2462  2464  2465
##     4     3     4     1     2     2     4     1     1     3     2     3     4
##  2466  2467  2469  2473  2475  2476  2477  2483  2484  2488  2490  2491  2492
##     2     4     4     3     2     3     2     3     2     3     4     3     3
##  2495  2496  2497  2498  2502  2503  2509  2513  2520  2523  2525  2526  2529
##     4     4     4     4     2     3     2     2     4     4     3     4     4
##  2534  2536  2537  2539  2544  2548  2550  2555  2556  2558  2563  2564  2567
##     3     4     2     3     2     3     2     3     4     2     2     3     2
##  2574  2579  2580  2581  2585  2593  2597  2603  2604  2605  2609  2611  2618
##     3     4     4     3     4     1     4     4     2     2     4     2     2
```

```
##  2622  2625  2633  2635  2638  2665  2667  2677  2699  2733  2734  2740  2762
##     2     2     1     3     1     3     3     3     2     1     3     3     1
##  2775  2781  2792  2813  2838  2842  2850  2852  2877  2879  2880  2883  2893
##     4     3     2     4     1     3     2     3     3     3     3     1     3
##  2898  2902  2905  2911  2912  2914  2915  2916  2922  2932  2934  2935  2936
##     2     3     3     2     3     3     1     3     3     3     3     3     3
##  2951  2955  2958  2967  2971  2972  2977  2978  2985  2992  2996  3002  3003
##     3     3     3     2     3     3     3     2     3     2     2     1     3
##  3008  3011  3014  3016  3023  3026  3029  3033  3034  3037  3039  3041  3047
##     3     3     3     2     3     2     3     3     1     3     3     2     3
##  3054  3055  3056  3067  3069  3078  3080  3091  3092  3098  3100  3107  3108
##     3     3     2     3     3     2     3     2     2     3     2     1     2
##  3116  3119  3123  3126  3127  3134  3136  3139  3142  3143  3144  3146  3147
##     3     3     2     2     4     2     2     3     3     4     3     4     1
##  3149  3156  3160  3163  3165  3168  3178  3180  3181  3186  3187  3188  3190
##     4     1     4     3     3     4     3     1     4     1     2     2     4
##  3192  3196  3199  3200  3201  3215  3231  3239  3254  3260  3263  3265  3269
##     3     3     3     4     4     2     2     3     2     2     2     2     3
##  3276  3288  3292  3298  3299  3315  3321  3322  3323  3333  3334  3348  3356
##     2     3     2     4     3     3     3     3     2     1     2     1     3
##  3362  3379  3380  3395  3403  3406  3412  3419  3428  3433  3439  3445  3462
##     1     2     3     2     2     3     2     2     3     2     3     4     3
##  3465  3486  3491  3492  3493  3494  3498  3503  3504  3511  3516  3529  3534
##     3     2     4     2     2     3     2     2     2     3     3     3     3
##  3543  3544  3550  3553  3560  3562  3565  3567  3569  3571  3572  3573  3574
##     2     2     2     2     3     2     2     2     2     2     2     2     3
##  3576  3577  3579  3587  3588  3596  3598  3600  3605  3606  3608  3609  3610
##     2     1     2     3     3     3     2     3     1     3     2     2     2
##  3611  3613  3614  3619  3622  3623  3626  3628  3635  3640  3650  3659  3660
##     3     3     3     2     3     3     4     3     3     4     3     3     1
##  3664  3665  3670  3675  3680  3681  3689  3697  3705  3706  3707  3708  3714
##     2     4     3     3     2     3     1     3     3     3     4     2     2
##  3715  3718  3720  3728  3730  3731  3732  3736  3740  3742  3751  3756  3757
##     3     3     2     1     4     1     3     1     4     1     3     3     3
##  3764  3767  3769  3774  3775  3781  3791  3818  3820  3839  3874  3903  3911
##     3     3     3     3     4     1     1     3     2     1     3     1     2
##  3925  3927  3930  3934  3946  3953  3957  3960  3964  3969  3971  3975  3989
##     3     3     4     3     3     3     3     3     3     3     3     4     3
##  3990  3991  3992  4000  4007  4013  4014  4018  4020  4024  4030  4032  4033
##     3     2     3     3     3     1     3     2     1     3     1     3     3
##  4035  4039  4042  4044  4045  4051  4055  4062  4067  4069  4070  4071  4074
##     4     3     2     3     3     3     3     1     1     3     4     3     1
##  4078  4084  4096  4114  4132  4135  4141  4143  4145  4147  4149  4156  4170
##     1     4     3     1     1     3     4     2     2     2     4     1     3
##  4178  4180  4184  4187  4189  4196  4203  4206  4209  4210  4219  4220  4223
##     2     2     4     1     2     2     4     3     3     4     4     3     3
##  4233  4240  4246  4257  4271  4275  4278  4282  4288  4293  4297  4299  4307
##     3     2     2     3     4     4     3     4     3     1     2     3     4
##  4310  4317  4328  4329  4338  4344  4346  4350  4361  4363  4374  4375  4391
##     1     2     3     3     3     4     3     3     1     3     3     3     3
##  4402  4413  4414  4417  4425  4426  4430  4431  4444  4454  4458  4463  4469
##     4     1     2     2     4     3     2     3     3     1     4     4     1
```

```
##  4471  4473  4493  4498  4500  4516  4529  4531  4533  4538  4557  4562  4564
##     3     3     4     2     4     3     4     4     1     1     4     3     1
##  4567  4569  4573  4577  4579  4584  4586  4588  4592  4598  4603  4606  4612
##     2     3     1     3     3     2     2     3     3     1     3     2     3
##  4623  4628  4638  4652  4656  4657  4680  4686  4687  4688  4689  4698  4706
##     3     3     3     3     3     4     3     2     2     2     3     3     1
##  4707  4714  4715  4716  4727  4742  4751  4768  4774  4776  4784  4787  4792
##     3     2     3     3     3     3     2     4     2     3     2     2     4
##  4805  4814  4835  4841  4851  4855  4856  4861  4864  4868  4875  4877  4878
##     3     2     3     2     3     3     2     2     4     3     3     4     3
##  4894  4895  4902  4903  4907  4909  4912  4915  4918  4921  4928  4942  4962
##     4     2     2     2     3     3     3     4     4     1     3     2     2
##  4969  4972  4982  4984  4990  5038  5042  5075  5093  5109  5111  5120  5128
##     2     2     2     1     3     4     4     3     3     1     4     3     3
##  5131  5226  5249  5261  5273  5281  5294  5315  5316  5317  5318  5321  5325
##     3     1     3     3     1     1     3     3     3     3     1     4     2
##  5327  5338  5340  5342  5345  5346  5348  5351  5352  5353  5358  5359  5362
##     3     4     2     3     2     3     2     3     3     2     2     1     2
##  5375  5380  5392  5400  5406  5418  5420  5422  5441  5442  5451  5466  5487
##     4     2     3     2     3     1     2     2     3     4     2     2     3
##  5491  5498  5505  5507  5522  5534  5535  5559  5603  5650  5654  5660  5678
##     1     3     3     3     2     4     3     3     3     3     3     2     3
##  5679  5680  5682  5684  5689  5699  5705  5707  5709  5710  5720  5729  5730
##     3     2     3     1     2     3     3     3     3     3     2     4     2
##  5732  5733  5734  5735  5737  5740  5756  5757  5762  5775  5779  5784  5793
##     4     2     2     3     2     1     3     2     3     2     3     3     2
##  5796  5797  5799  5801  5804  5806  5808  5820  5822  5835  5836  5839  5840
##     3     2     3     3     3     3     3     3     1     3     3     3     2
##  5841  5851  5853  5856  5861  5864  5868  5878  5885  5900  5929  5931  5940
##     3     3     3     3     3     1     4     3     4     3     2     1     2
##  5950  5952  5962  5963  5973  5977  5978  5981  5984  5985  5987  5991  5992
##     1     3     2     3     2     1     2     3     3     2     1     3     3
##  5994  5995  6003  6004  6006  6007  6008  6010  6013  6019  6020  6023  6028
##     3     1     2     2     3     3     3     3     2     2     2     2     3
##  6029  6032  6033  6034  6037  6039  6040  6041  6042  6043  6045  6047  6049
##     2     2     3     2     3     3     3     4     2     2     3     3     3
##  6051  6058  6060  6061  6064  6065  6068  6069  6072  6074  6076  6078  6080
##     3     2     3     3     2     2     3     2     2     3     3     1     3
##  6084  6085  6087  6088  6090  6096  6098  6099  6100  6101  6102  6103  6104
##     2     1     2     3     3     1     2     3     2     2     3     2     1
##  6105  6107  6108  6112  6114  6115  6118  6120  6123  6127  6130  6131  6132
##     2     2     2     3     3     2     2     3     2     3     3     3     3
##  6133  6136  6137  6138  6140  6141  6147  6148  6150  6152  6153  6154  6157
##     3     3     2     3     3     3     3     2     2     1     2     4     2
##  6161  6163  6164  6171  6174  6175  6176  6177  6179  6183  6185  6186  6188
##     2     1     2     2     3     3     3     2     3     2     4     2     3
##  6189  6192  6200  6204  6207  6210  6211  6212  6217  6218  6219  6221  6223
##     2     3     2     3     2     3     1     2     3     3     2     3     3
##  6226  6227  6231  6232  6233  6236  6238  6239  6240  6242  6245  6249  6250
##     2     3     3     3     3     1     2     3     3     3     4     3     3
##  6251  6253  6254  6256  6258  6262  6263  6266  6271  6272  6274  6276  6278
##     3     2     3     3     3     2     1     3     2     3     3     3     3
```

```
##  6284  6285  6286  6287  6289  6292  6294  6303  6305  6306  6315  6323  6324
##     3     3     3     3     3     3     3     1     4     2     3     3     2
##  6328  6329  6330  6331  6332  6334  6336  6337  6339  6344  6346  6347  6350
##     1     3     3     4     1     3     2     3     3     2     2     3     1
##  6352  6355  6360  6362  6365  6370  6371  6377  6379  6380  6383  6386  6387
##     3     2     3     3     2     3     3     3     3     2     3     3     3
##  6388  6389  6391  6397  6399  6403  6404  6406  6407  6408  6409  6411  6416
##     3     3     3     3     3     3     3     2     3     2     2     3     3
##  6417  6418  6419  6420  6421  6424  6428  6430  6431  6434  6437  6438  6439
##     4     2     3     3     3     3     2     2     2     1     2     3     3
##  6440  6442  6443  6445  6446  6447  6448  6452  6453  6455  6458  6459  6464
##     2     3     3     3     2     2     2     3     3     3     1     2     3
##  6467  6469  6471  6474  6476  6477  6478  6482  6483  6484  6487  6488  6489
##     3     3     3     3     3     3     3     2     3     3     3     3     3
##  6491  6492  6493  6495  6496  6497  6498  6499  6500  6501  6504  6505  6507
##     3     3     3     2     3     3     3     3     2     3     3     3     4
##  6509  6512  6516  6517  6518  6521  6523  6525  6526  6527  6529  6531  6538
##     2     3     3     2     2     2     3     3     3     3     2     3     3
##  6539  6540  6541  6543  6544  6545  6549  6550  6551  6552  6553  6554  6555
##     3     2     3     2     2     2     3     3     3     3     3     3     3
##  6556  6557  6559  6560  6563  6564  6567  6574  6575  6576  6578  6583  6585
##     3     3     3     2     3     1     3     3     3     3     4     4     2
##  6586  6589  6590  6594  6598  6603  6607  6611  6614  6616  6620  6622  6624
##     3     4     4     2     2     3     3     2     2     3     2     1     3
##  6625  6627  6630  6632  6633  6639  6640  6649  6650  6652  6653  6656  6658
##     2     4     3     3     4     2     3     3     4     3     3     4     3
##  6664  6667  6668  6669  6672  6674  6677  6679  6681  6682  6685  6686  6693
##     2     4     3     4     2     3     3     3     2     2     1     4     3
##  6696  6698  6704  6705  6707  6710  6712  6715  6719  6730  6734  6736  6740
##     3     4     4     4     3     3     3     2     3     2     3     4     2
##  6750  6751  6752  6753  6754  6756  6758  6759  6760  6762  6763  6767  6770
##     2     3     3     2     3     2     2     1     3     1     2     1     2
##  6776  6777  6778  6784  6788  6789  6790  6792  6794  6795  6797  6801  6802
##     2     3     2     2     3     3     2     3     3     2     2     3     3
##  6805  6806  6809  6810  6811  6812  6813  6814  6820  6821  6824  6828  6832
##     3     3     3     3     3     2     3     3     3     2     3     3     3
##  6834  6835  6839  6841  6845  6847  6848  6849  6853  6857  6859  6860  6861
##     2     2     3     3     3     1     1     3     3     3     3     2     1
##  6862  6863  6864  6867  6870  6875  6876  6877  6879  6884  6885  6886  6889
##     2     2     2     2     3     3     2     3     3     3     2     2     3
##  6890  6892  6894  6896  6903  6904  6905  6910  6911  6912  6913  6920  6923
##     3     3     3     2     2     2     3     3     2     3     2     3     3
##  6925  6927  6930  6938  6942  6948  6951  6952  6957  6958  6967  6969  6972
##     3     2     3     3     1     2     3     3     3     2     2     2     4
##  6973  6976  6978  6986  6991  6996  7001  7003  7006  7008  7013  7016  7020
##     4     1     3     3     1     3     2     3     2     1     4     3     2
##  7023  7025  7034  7035  7042  7043  7047  7048  7049  7051  7058  7063  7064
##     3     2     4     2     3     4     4     2     4     3     4     3     4
##  7065  7066  7070  7071  7075  7082  7096  7101  7102  7111  7115  7120  7121
##     1     4     4     4     2     4     3     3     4     4     3     4     3
##  7122  7128  7131  7133  7137  7142  7143  7144  7147  7150  7165  7167  7175
##     4     4     2     4     3     4     1     4     4     3     2     1     3
```

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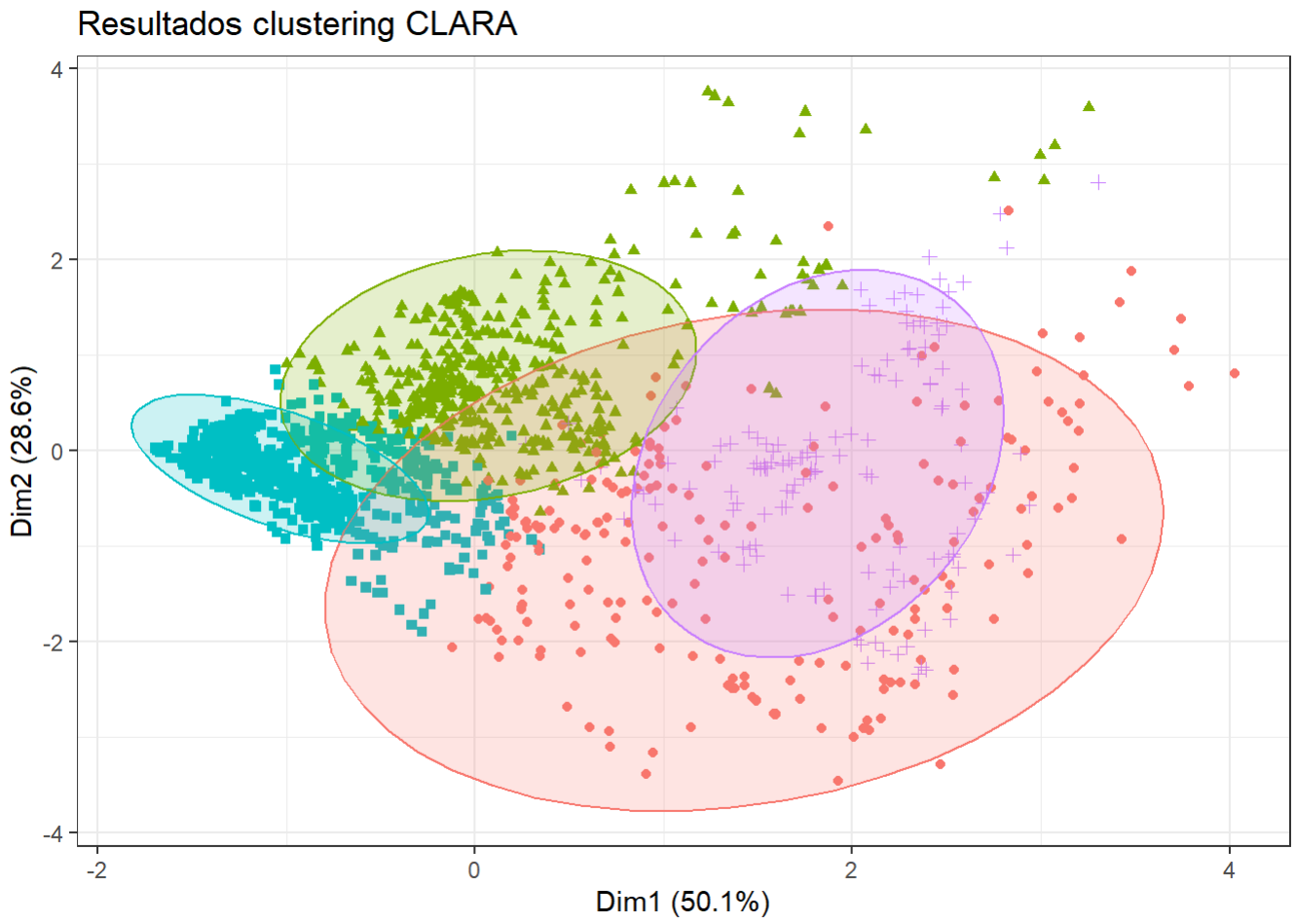
##  7177  7181  7185  7186  7214  7230  7234  7240  7247  7250  7256  7257  7259
##     1     3     2     4     2     2     2     1     3     4     2     3     4
##  7272  7273  7281  7284  7286  7287  7289  7290  7296  7303  7305  7308  7315
##     4     3     2     2     3     2     2     1     2     4     3     3     4
##  7323  7324  7329  7330  7333  7337  7340  7342  7347  7349  7352  7355  7356
##     2     3     2     2     3     3     3     4     3     2     3     3     3
##  7362  7363  7369  7372  7374  7379  7381  7389  7391  7392  7395  7396  7412
##     3     3     3     3     3     3     3     3     3     3     3     3     3
##  7413  7422  7440  7443  7447  7451  7456  7460  7462  7470  7471  7473  7479
##     3     4     4     4     3     2     2     3     4     3     2     3     3
##  7480  7486  7487  7488  7490  7496  7501  7521  7525  7537  7541  7545  7546
##     3     4     3     2     3     4     4     4     4     3     3     4     3
##  7547  7550  7552  7555  7557  7559  7560  7567  7569  7570  7571  7574  7576
##     2     3     4     4     3     4     2     3     4     4     1     3     2
##  7579  7580  7582  7588  7591  7595  7596  7597  7599  7611  7617  7624  7633
##     2     2     2     4     3     4     3     4     2     3     2     2     2
##  7634  7640  7655  7656  7668  7671  7672  7677  7678  7680  7686  7703  7713
##     2     4     1     4     4     2     3     3     4     4     2     1     3
##  7717  7729  7741  7742  7745  7754  7756  7758  7771  7773  7776  7781  7786
##     1     3     1     2     1     2     1     1     1     4     3     1     3
##  7790  7792  7795  7796  7807  7810  7812  7815  7820  7827  7843  7887  7890
##     1     1     1     1     1     2     3     3     2     3     2     3     3
##  7907  7945  7946  7963  7964  7969  7970  7976  7983  7985  7996  7997  8004
##     3     2     1     3     2     3     3     3     3     3     3     2     3
##  8009  8016  8018  8022  8024  8025  8027  8031  8040  8044  8046  8048  8050
##     1     2     1     3     3     3     2     3     3     2     3     3     3
##  8058  8076  8078  8080  8087  8091  8092  8099  8105  8114  8131  8138  8141
##     2     3     3     3     3     3     2     2     2     3     3     3     2
##  8148  8154  8161  8167  8168  8176  8186  8189  8193  8195  8198  8201  8203
##     3     3     2     1     3     3     1     3     3     3     3     2     3
##  8206  8207  8209  8218  8224  8242  8249  8258  8259  8261  8265  8267  8281
##     3     4     2     4     3     2     3     2     2     1     1     2     2
##  8282  8288  8296  8299  8307  8313  8316  8327  8329  8331  8332  8336  8348
##     3     3     4     2     3     3     2     1     1     3     4     3     2
##  8355  8362  8363  8365  8366  8371  8375  8377  8381  8384  8392  8393  8409
##     4     3     2     2     2     3     2     3     1     3     2     2     3
##  8410  8416  8418  8423  8427  8432  8434  8437  8449  8459  8464  8466  8470
##     3     3     3     4     2     2     1     2     2     2     2     3     2
##  8475  8481  8483  8484  8496  8503  8512  8514  8517  8521  8525  8530  8547
##     3     3     3     3     3     1     3     2     2     3     2     2     4
##  8550  8554  8567  8570  8574  8577  8584  8586  8588  8600  8604  8606  8608
##     3     4     3     2     2     2     2     1     2     2     2     3     4
##  8609  8611  8612  8616  8617  8619  8620  8625  8627  8630  8631  8633  8635
##     2     2     2     2     2     3     2     2     3     2     2     3     2
##  8641  8643  8644  8647  8651  8655  8657  8660  8661  8663  8666  8667  8668
##     3     3     2     3     2     1     3     4     3     2     2     2     3
##  8669  8671  8676  8677  8680  8684  8687  8701  8702  8704  8706  8707  8708
##     3     1     1     3     2     2     3     3     1     1     3     3     2
##  8711  8714  8721  8724  8727  8731  8741  8759  8764  8786  8810  8815  8824
##     2     3     4     3     1     3     3     3     3     1     4     3     3
##  8835  8875  8879  8893  8916  8956  8961  8967  8969  8970  8972  8976  8977
##     3     4     3     2     3     3     3     3     3     3     1     3     3
```

```
##  8978  8981  8983  8984  8986  8991  9002  9003  9004  9007  9008  9016  9022
##     1     3     1     3     1     3     2     3     1     3     1     2     4
##  9025  9027  9029  9031  9034  9036  9040  9045  9048  9049  9052  9054  9055
##     2     3     2     1     3     2     4     2     3     3     3     3     4
##  9057  9060  9064  9070  9071  9072  9078  9089  9091  9093  9096  9100  9108
##     4     3     3     1     3     3     4     4     3     3     1     3     4
##  9110  9112  9116  9117  9119  9120  9129  9133  9136  9145  9153  9158  9173
##     4     1     4     2     3     3     3     4     2     3     3     4     2
##  9179  9180  9189  9195  9197  9201  9204  9216  9218  9226  9227  9229  9237
##     3     3     4     3     3     2     2     3     1     1     3     2     3
##  9238  9247  9260  9261  9262  9268  9271  9279  9282  9288  9295  9297  9300
##     3     3     3     1     1     4     4     2     4     3     4     3     3
##  9303  9304  9308  9318  9320  9335  9339  9340  9342  9349  9350  9353  9377
##     3     3     1     4     3     4     4     3     4     4     3     3     3
##  9387  9389  9390  9392  9394  9397  9406  9422  9427  9439  9449  9451  9453
##     4     3     4     2     1     1     3     4     1     3     4     3     3
##  9458  9477  9483  9487  9488  9507  9526  9532  9534  9536  9538  9541  9549
##     4     1     3     4     2     3     3     1     3     3     4     3     2
##  9555  9559  9561  9571  9572  9578  9579  9597  9598  9605  9609  9613  9619
##     2     3     1     1     4     4     3     1     3     1     3     4     3
##  9625  9634  9637  9640  9641  9643  9649  9655  9658  9669  9673  9675  9679
##     3     3     3     3     1     1     3     3     1     1     3     3     4
##  9683  9684  9685  9689  9711  9727  9752  9762  9775  9777  9783  9785  9798
##     3     3     1     1     3     3     3     1     2     3     2     3     1
##  9807  9828  9831  9834  9836  9843  9858  9860  9866  9867  9873  9875  9878
##     3     3     2     3     2     4     2     4     3     3     3     2     3
##  9880  9881  9887  9890  9892  9905  9909  9936  9943  9946  9952  9953  9965
##     3     2     3     2     4     3     3     4     3     3     1     3     2
##  9970  9972  9975  9991  9994  9996 10000 10003 10004
##     2     3     3     3     1     2     4     1     3
```

```
table(clara_clusters$clustering)
```

```
##
##    1    2    3    4
##  249  611 1074  285
```

```
fviz_cluster(object = clara_clusters, ellipse.type = "t", geom = "point",
             pointsize = 1.5) +  theme_bw() +
  labs(title = "Resultados clustering CLARA") +
  theme(legend.position = "none")
```



Seitán

```
clara_clusters <- clara(x = scale(df_seitan[,-1]), k = 3, metric = "manhattan", stand = TRUE,
                        samples = 60, pamLike = TRUE)
clara_clusters$sample
```

```
##  [1] "473"  "816"  "824"  "1304" "2172" "2207" "2215" "2535" "2952" "3138"
## [11] "3267" "3833" "3838" "3855" "3872" "4212" "4309" "4539" "4789" "5874"
## [21] "5902" "5906" "6144" "6265" "6322" "7085" "7213" "8185" "8196" "8230"
## [31] "8674" "8816" "8818" "8826" "8836" "8922" "8937" "8941" "9104" "9155"
## [41] "9274" "9310" "9370" "9452" "9607" "9801"
```

```
clara_clusters$medoids
```

```
##      PROTEINS_100G CARBOHYDRATES_100G   FAT_100G
## 1304   -0.02248502         -0.2593732 -0.8193032
## 7213    0.77541035         -0.2987133  1.0728682
## 3267   -0.89291633          1.2945632  1.0956655
```

```
clara_clusters$i.med
```

```
## [1]  86 426 177
```

```
clara_clusters$clustering
```

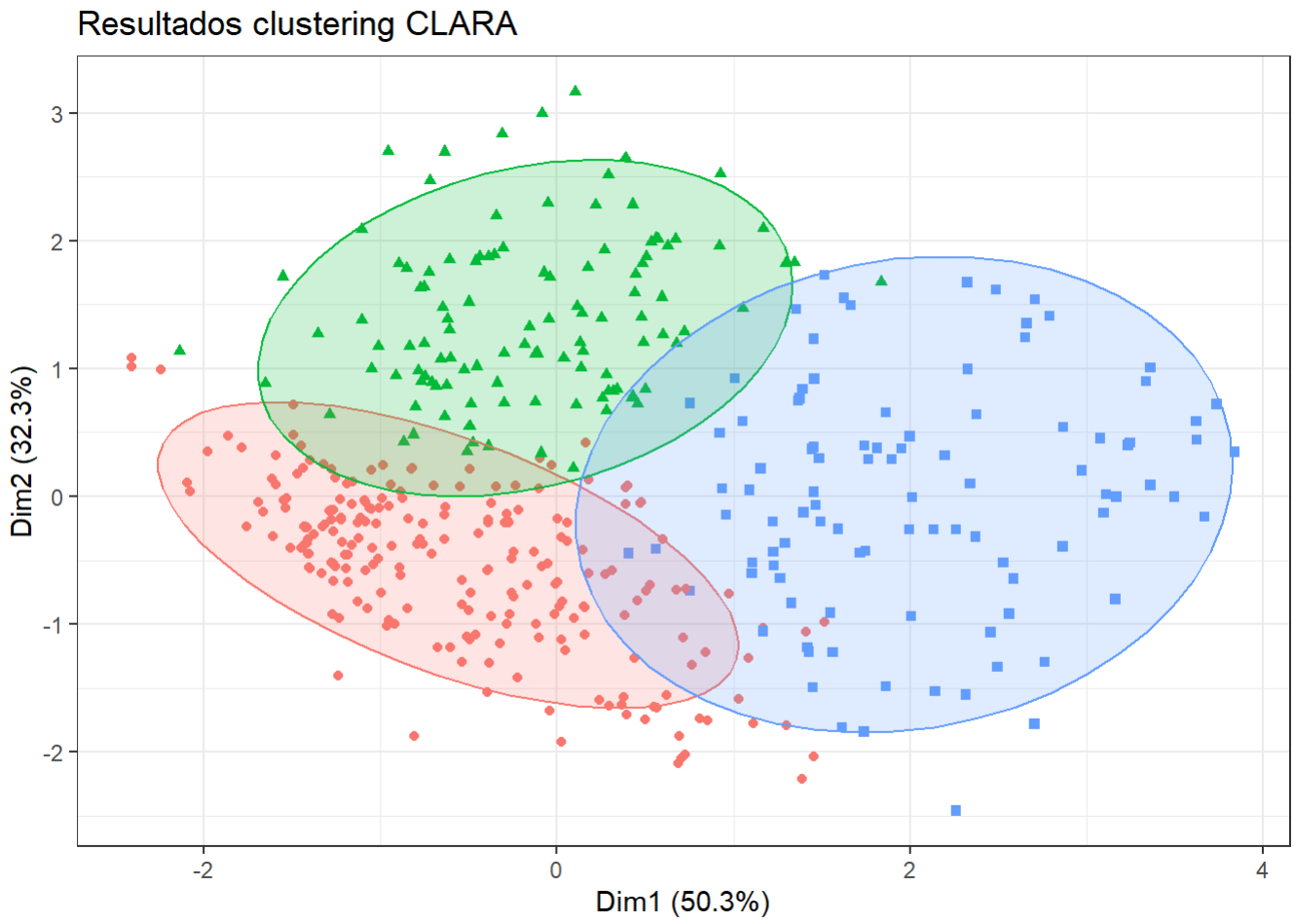
```
##   16   20   29   32   38  104  105  114  131  133  135  138  147  262  318  368
##    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
##  385  455  471  472  473  490  513  517  533  541  558  568  569  571  572  581
##    2    1    1    1    1    1    1    1    1    3    3    1    1    3    3    2
##  592  597  673  700  719  753  765  809  816  824  828  829  845  857  871  872
##    1    1    2    2    2    3    3    1    1    1    1    1    1    1    1    1
##  891  899  900  902  903  904  905  906  909  910  915  916  918  920  922  923
##    3    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
##  926  933  934  937  939  942  947  948  952  957  982  993 1036 1151 1158 1170
##    1    1    1    1    1    1    1    1    1    3    1    1    1    1    1    3
## 1209 1240 1247 1265 1277 1304 1336 1351 1361 1368 1421 1622 1881 2036 2060 2078
##    3    3    3    3    3    1    1    2    1    2    1    3    3    1    3    1
## 2081 2129 2132 2135 2172 2178 2189 2190 2196 2207 2215 2231 2233 2234 2245 2255
##    1    2    1    3    1    1    2    2    1    2    2    2    2    2    2    1
## 2263 2367 2424 2436 2450 2451 2458 2459 2463 2489 2500 2504 2505 2535 2543 2547
##    2    2    3    2    2    2    2    1    2    2    2    2    2    2    2    2
## 2557 2560 2570 2576 2630 2664 2697 2716 2749 2774 2891 2900 2910 2928 2930 2945
##    2    1    2    3    3    1    3    3    1    1    1    1    1    1    1    3
## 2952 2973 2983 3012 3017 3032 3062 3085 3088 3094 3096 3102 3103 3111 3112 3128
##    2    1    3    1    1    3    1    1    1    1    1    1    3    1    1    1
## 3130 3133 3138 3153 3154 3155 3161 3173 3175 3176 3177 3179 3191 3193 3194 3211
##    1    1    1    3    1    1    2    1    1    2    1    1    3    1    3    1
## 3267 3278 3346 3463 3482 3509 3522 3604 3643 3646 3666 3743 3746 3750 3760 3765
##    3    2    2    3    1    1    1    1    2    1    1    1    3    1    1    1
## 3771 3779 3784 3786 3787 3789 3794 3797 3805 3811 3813 3814 3816 3817 3833 3836
##    1    1    2    1    1    3    1    1    1    1    3    2    1    1    2    1
## 3838 3840 3844 3845 3846 3848 3849 3855 3861 3862 3864 3865 3870 3872 3876 3880
##    3    1    1    1    1    1    1    1    2    1    1    1    3    1    2    1
## 3883 3890 3896 3900 3907 3917 3924 3929 3933 3937 3941 3942 3944 3959 3998 4025
##    1    1    1    1    1    3    1    1    2    1    2    2    1    1    1    1
## 4031 4047 4053 4073 4087 4094 4098 4099 4109 4117 4118 4120 4137 4139 4140 4160
##    1    3    1    2    2    3    1    1    1    3    3    1    3    1    1    1
## 4162 4167 4173 4174 4177 4190 4205 4212 4218 4222 4229 4230 4236 4252 4260 4262
##    1    3    1    3    1    1    1    1    1    1    1    1    3    3    1    1
## 4266 4272 4281 4291 4292 4300 4306 4309 4313 4316 4318 4320 4323 4326 4327 4343
##    1    1    2    1    3    1    1    1    1    3    2    1    3    1    1    2
## 4351 4360 4362 4369 4383 4397 4401 4403 4405 4419 4439 4440 4446 4470 4474 4484
##    3    1    3    3    3    1    3    2    2    3    2    2    3    2    2    1
## 4513 4527 4539 4552 4575 4580 4731 4748 4789 4825 4881 4983 5121 5196 5211 5214
##    1    1    1    1    2    1    1    2    2    3    1    1    1    2    1    1
## 5239 5293 5295 5297 5372 5373 5377 5388 5390 5398 5403 5404 5447 5464 5465 5467
##    1    1    1    1    1    2    2    3    2    1    2    2    1    1    1    1
## 5470 5477 5495 5511 5520 5521 5529 5541 5542 5544 5567 5577 5587 5594 5596 5614
##    2    1    3    1    2    2    2    1    1    2    3    2    1    1    1    3
## 5783 5785 5807 5811 5812 5818 5819 5831 5859 5867 5869 5871 5873 5874 5875 5876
##    1    1    1    1    1    1    1    1    2    1    1    1    1    1    1    1
## 5877 5879 5882 5883 5888 5891 5894 5896 5899 5901 5902 5906 5908 5909 5912 5913
##    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
## 5914 5915 5916 5917 5922 5925 5930 5934 5939 5959 5961 5970 5998 6050 6056 6144
##    1    1    1    1    1    1    1    1    1    1    1    1    1    3    3    1
## 6257 6265 6300 6309 6318 6322 6327 6340 6354 6394 6410 6546 6665 6722 6738 6955
##    1    3    1    3    3    3    3    3    3    1    2    2    1    1    1    1
```

```
## 6971 7032 7085 7104 7114 7184 7195 7198 7208 7213 7215 7227 7243 7246 7254 7265
##    3    3    3    1    1    2    2    1    1    2    1    2    1    1    2    2
## 7268 7275 7302 7306 7330 7341 7376 7424 7476 7503 7519 7529 7533 7535 7536 7542
##    2    2    2    2    3    3    3    3    1    1    2    2    2    2    2    2
## 7551 7573 7577 7583 7600 7631 7642 7644 7645 7654 7663 7665 7679 7684 7685 7735
##    2    2    2    2    2    2    2    2    2    2    2    2    2    2    2    3
## 7766 7806 7931 7952 7960 7962 7990 8029 8052 8057 8070 8084 8101 8160 8170 8180
##    1    2    3    1    1    3    1    1    1    3    1    1    1    1    2    1
## 8181 8184 8185 8190 8196 8197 8199 8221 8222 8226 8230 8231 8233 8234 8251 8270
##    1    1    1    3    1    1    3    1    3    1    1    1    3    1    1    1
## 8302 8310 8317 8400 8599 8622 8653 8659 8674 8710 8723 8736 8738 8744 8745 8747
##    3    1    3    2    3    1    2    1    2    1    1    3    1    3    1    1
## 8750 8753 8767 8774 8779 8780 8787 8793 8796 8805 8806 8816 8818 8825 8826 8829
##    1    3    1    1    2    1    1    1    1    1    1    1    1    1    3    1
## 8832 8833 8836 8838 8840 8841 8842 8845 8848 8850 8851 8853 8854 8860 8874 8877
##    2    2    2    1    2    1    1    1    1    3    1    1    3    1    1    1
## 8889 8895 8901 8904 8906 8922 8924 8927 8937 8941 8943 8950 8952 9046 9058 9085
##    1    1    1    1    1    1    1    3    1    2    2    1    1    2    1    1
## 9104 9125 9141 9146 9154 9155 9156 9162 9163 9178 9181 9182 9188 9191 9192 9217
##    3    3    1    1    3    2    3    1    1    3    1    1    1    1    1    1
## 9222 9234 9236 9249 9257 9258 9274 9283 9292 9293 9296 9309 9310 9326 9344 9345
##    3    1    3    1    1    1    3    2    1    3    3    2    2    1    3    1
## 9355 9370 9393 9402 9404 9407 9409 9411 9429 9436 9446 9450 9452 9464 9468 9475
##    3    3    2    3    1    1    2    3    1    2    2    1    1    2    3    3
## 9495 9497 9501 9506 9516 9521 9527 9528 9563 9580 9583 9593 9607 9616 9621 9678
##    2    3    1    1    2    1    1    1    1    2    2    3    2    2    1    1
## 9773 9789 9800 9801 9833
##    1    1    2    2    2
```

```
table(clara_clusters$clustering)
```

```
##
##   1   2   3
## 377 137 115
```

```
fviz_cluster(object = clara_clusters, ellipse.type = "t", geom = "point",
             pointsize = 1.5) +  theme_bw() +
  labs(title = "Resultados clustering CLARA") +
  theme(legend.position = "none")
```



Tofu

```
df_tofu <- na.omit(df_tofu)


clara_clusters <- clara(x = scale(df_tofu[,-1]), k = 3, metric = "manhattan", stand = TRUE,
                        samples = 60, pamLike = TRUE)
clara_clusters$sample
```

```
##  [1] "34"   "218"  "275"  "506"  "601"  "1431" "1943" "1955" "1984" "2155"
## [11] "2194" "2510" "2741" "3547" "3559" "3717" "3881" "3940" "4679" "5034"
## [21] "5084" "5207" "5222" "5228" "5397" "5473" "5550" "5551" "5633" "5711"
## [31] "5803" "6975" "6995" "7197" "7280" "7368" "7612" "7658" "7973" "8121"
## [41] "8404" "8856" "8938" "9177" "9248" "9502"
```

```
clara_clusters$medoids
```

```
##      PROTEINS_100G CARBOHYDRATES_100G    FAT_100G
## 1431     0.6526350         -0.6222919  0.09686495
## 5711    -0.9897297          1.8411453 -0.06455252
## 5397    -0.7189840         -0.4994559 -0.80110451
```

```
clara_clusters$i.med
```

```
## [1]  461 1553 1428
```

```
clara_clusters$clustering
```

```
##     3     4     6     7     8    13    18    19    22    31    33    34    35
##     1     2     1     2     1     3     3     1     1     1     2     1     3
##    41    42    43    48    49    51    54    55    57    58    59    60    61
##     3     3     3     3     3     2     1     1     2     2     1     3     2
##    62    63    65    66    67    68    69    70    71    72    74    76    77
##     3     1     3     3     3     1     3     3     3     1     3     3     3
##    81    84    85    86    87    88    89    91    92    93    94    96    98
##     1     2     3     3     3     3     1     1     1     3     3     1     3
##   100   102   106   107   108   109   110   112   113   115   116   117   118
##     3     3     3     1     1     2     3     1     3     1     2     2     3
##   119   120   122   123   124   125   126   127   128   129   132   134   137
##     3     3     2     1     2     2     2     3     3     3     3     1     3
##   139   141   142   143   144   146   149   152   153   155   156   158   159
##     1     3     2     2     3     1     2     3     3     1     2     3     1
##   163   164   166   167   168   171   173   175   177   178   180   184   187
##     1     1     3     1     3     1     3     1     3     1     3     3     1
##   189   190   191   192   193   194   195   196   197   199   201   202   205
##     1     3     2     2     1     3     3     1     3     1     1     1     1
##   206   208   209   212   215   216   217   218   220   221   222   224   225
##     1     1     1     1     1     2     1     1     1     3     1     1     1
##   228   229   231   234   236   237   238   241   242   243   244   245   248
##     1     1     3     3     3     3     3     3     3     3     3     3     3
##   250   251   252   254   256   257   259   260   263   264   265   267   268
##     1     3     3     3     3     3     1     1     3     3     3     1     2
##   269   270   271   272   274   275   276   277   278   283   290   297   302
##     3     3     3     1     3     3     3     3     3     3     3     3     3
##   303   306   310   311   313   315   316   320   321   322   323   324   330
##     3     3     2     3     3     3     3     2     1     3     3     3     2
##   333   334   335   336   350   351   353   355   356   358   361   363   369
##     3     3     3     3     3     2     3     3     1     3     3     1     1
##   382   383   390   392   394   397   399   402   409   414   418   423   424
##     2     2     3     3     1     3     2     1     1     3     3     1     1
##   425   430   431   434   435   436   445   448   453   456   457   460   461
##     3     2     1     3     1     3     2     2     1     3     1     3     3
##   465   467   469   478   483   488   489   492   495   496   499   500   503
##     3     2     1     3     3     3     3     1     3     1     2     1     3
##   505   506   509   510   511   516   518   522   525   526   527   528   530
##     3     3     3     1     3     2     1     2     1     3     3     3     3
##   534   535   536   537   538   543   544   546   548   549   554   555   559
##     3     1     3     3     2     1     2     1     2     3     1     1     1
##   560   562   565   572   576   577   579   580   583   584   587   589   590
##     3     1     2     2     1     3     3     2     3     3     1     3     1
##   595   596   598   600   601   603   604   605   606   608   609   610   614
##     2     3     1     3     1     1     3     3     2     2     3     2     2
##   618   619   620   621   623   624   626   627   628   630   631   633   634
##     2     1     2     1     3     1     2     3     3     2     3     3     3
##   635   636   637   638   645   650   651   653   655   656   657   660   661
##     2     3     1     1     2     3     1     1     1     1     1     2     1
##   668   670   671   674   676   679   680   682   685   691   692   693   697
##     3     2     3     1     2     3     2     3     1     1     3     3     1
##   698   699   700   703   718   721   726   733   736   738   740   746   747
##     3     3     1     3     1     1     1     3     3     1     1     3     1
```

```
##   752   755   756   757   761   769   773   782   785   792   795   800   801
##     3     3     1     1     2     3     3     1     3     3     1     1     1
##   802   804   806   807   808   810   813   818   819   821   826   827   830
##     1     2     1     1     1     1     1     1     1     1     1     3     1
##   831   838   842   846   848   862   864   866   870   874   878   883   885
##     1     2     2     1     3     3     1     2     1     3     1     1     1
##   888   889   890   893   907   914   921   928   936   943   945   949   953
##     1     1     1     1     1     2     3     1     3     1     1     1     1
##   954   958   960   961   964   969   972   974   976   986   988   989   990
##     1     1     1     3     1     1     3     1     1     1     1     1     1
##  1006  1011  1016  1034  1038  1045  1048  1052  1053  1061  1063  1065  1069
##     1     1     1     1     1     1     2     3     1     2     1     1     2
##  1071  1075  1076  1082  1087  1088  1090  1093  1109  1120  1123  1125  1127
##     2     1     2     3     3     2     1     1     3     2     3     1     1
##  1157  1174  1177  1183  1205  1207  1213  1217  1218  1223  1230  1236  1241
##     3     3     1     2     3     2     1     1     1     3     2     1     2
##  1242  1243  1244  1258  1260  1269  1273  1274  1280  1287  1290  1300  1309
##     1     1     3     3     3     3     1     2     1     1     1     1     1
##  1310  1313  1317  1397  1427  1431  1443  1468  1494  1534  1538  1541  1542
##     2     1     1     1     2     1     2     3     1     2     3     1     1
##  1550  1572  1578  1598  1599  1600  1602  1605  1606  1612  1613  1614  1617
##     1     1     3     1     1     1     2     3     1     3     2     2     1
##  1621  1633  1637  1638  1643  1646  1648  1651  1653  1655  1657  1658  1663
##     1     1     2     2     1     3     1     1     1     1     2     1     2
##  1664  1670  1671  1672  1673  1678  1702  1720  1735  1766  1771  1772  1777
##     1     1     1     1     2     1     3     2     1     2     1     2     1
##  1807  1808  1815  1825  1832  1837  1838  1841  1847  1848  1850  1852  1858
##     1     1     1     1     1     1     1     1     2     2     1     2     3
##  1861  1863  1867  1874  1890  1897  1912  1915  1919  1923  1925  1929  1936
##     2     3     2     2     2     2     1     1     1     3     3     1     3
##  1943  1944  1947  1954  1955  1958  1959  1960  1968  1969  1970  1973  1974
##     2     3     2     1     2     3     1     1     2     3     1     1     2
##  1982  1983  1984  1993  1995  2008  2018  2023  2027  2032  2039  2043  2045
##     3     3     2     3     3     1     3     3     2     2     1     1     3
##  2049  2056  2063  2067  2072  2108  2111  2112  2117  2120  2121  2122  2123
##     1     3     3     1     1     1     1     1     1     1     1     1     2
##  2126  2127  2134  2136  2138  2139  2140  2144  2146  2149  2152  2154  2155
##     1     1     3     1     1     1     1     3     1     1     1     2     1
##  2156  2157  2159  2160  2163  2164  2166  2167  2169  2170  2171  2173  2174
##     1     1     1     2     1     1     1     2     1     1     2     1     1
##  2176  2179  2180  2183  2186  2187  2188  2191  2194  2198  2199  2200  2202
##     2     3     2     2     1     1     1     1     3     1     1     1     1
##  2205  2206  2210  2214  2221  2224  2228  2230  2232  2238  2240  2241  2243
##     2     1     1     1     1     2     1     1     1     1     1     1     1
##  2244  2246  2248  2249  2250  2251  2253  2259  2265  2272  2276  2280  2284
##     1     3     2     1     1     3     1     1     1     1     1     1     1
##  2285  2290  2291  2298  2301  2302  2304  2306  2310  2315  2317  2318  2321
##     2     1     1     1     1     3     3     1     2     1     1     1     1
##  2322  2323  2327  2329  2336  2339  2342  2343  2347  2349  2352  2353  2355
##     3     1     1     1     1     3     1     1     1     1     1     1     1
##  2357  2359  2365  2372  2379  2380  2382  2388  2389  2390  2393  2394  2397
##     1     3     1     1     1     1     1     1     1     1     1     1     1
```

```
##  2402  2404  2405  2406  2407  2408  2411  2412  2414  2419  2420  2421  2433
##     1     1     1     1     1     1     1     1     1     1     1     1     1
##  2435  2442  2443  2445  2447  2461  2470  2472  2481  2482  2499  2501  2506
##     1     1     1     1     1     1     3     1     3     1     1     1     1
##  2508  2510  2514  2515  2516  2519  2528  2530  2538  2540  2549  2554  2561
##     1     1     1     1     1     1     1     1     1     1     1     3     3
##  2569  2573  2576  2578  2583  2586  2590  2591  2592  2598  2599  2601  2602
##     1     1     1     1     2     1     3     1     1     1     1     1     2
##  2606  2612  2613  2616  2621  2626  2628  2640  2650  2656  2665  2673  2676
##     1     1     1     1     3     2     2     3     2     1     3     3     3
##  2692  2700  2707  2708  2709  2712  2723  2729  2737  2739  2741  2746  2750
##     1     3     1     1     2     3     3     1     2     3     2     1     3
##  2752  2753  2754  2760  2763  2768  2769  2773  2778  2780  2786  2790  2803
##     1     2     1     1     1     1     1     1     1     2     2     1     3
##  2804  2805  2810  2811  2814  2816  2819  2825  2826  2829  2834  2836  2839
##     2     1     1     1     2     1     1     3     1     2     1     2     3
##  2847  2863  2864  2867  2886  2899  2901  2941  2949  2969  2976  2979  3004
##     1     3     2     1     1     3     3     1     1     1     1     3     1
##  3021  3025  3061  3074  3076  3087  3104  3105  3106  3122  3129  3137  3140
##     1     1     1     1     3     1     1     3     1     1     3     1     1
##  3152  3172  3174  3202  3204  3205  3206  3208  3209  3214  3222  3223  3224
##     3     1     3     1     1     1     1     1     3     3     1     1     1
##  3227  3229  3234  3236  3238  3241  3250  3251  3262  3264  3271  3272  3277
##     1     1     1     1     1     1     1     1     2     1     3     2     1
##  3294  3297  3306  3308  3309  3316  3327  3329  3332  3335  3340  3342  3360
##     1     1     1     1     1     1     1     2     3     1     1     1     1
##  3366  3375  3390  3401  3405  3422  3430  3431  3434  3441  3447  3451  3454
##     1     1     3     1     1     1     1     1     2     3     3     2     3
##  3455  3458  3459  3460  3471  3474  3484  3495  3496  3499  3515  3528  3530
##     2     1     3     1     2     2     1     1     1     1     3     1     2
##  3531  3536  3539  3545  3547  3548  3549  3551  3552  3555  3556  3557  3558
##     1     1     1     3     2     1     2     1     1     1     1     1     1
##  3559  3561  3566  3568  3570  3578  3580  3581  3582  3583  3585  3589  3590
##     2     2     1     1     2     1     3     1     1     3     2     1     2
##  3591  3593  3594  3595  3597  3599  3606  3607  3615  3616  3617  3618  3621
##     3     3     1     1     2     2     3     1     1     1     1     1     1
##  3627  3629  3633  3636  3645  3647  3648  3669  3671  3674  3683  3702  3703
##     2     3     1     3     1     1     1     3     1     1     1     1     1
##  3717  3719  3723  3745  3748  3749  3752  3753  3755  3758  3761  3772  3780
##     1     3     1     3     2     2     1     1     2     1     2     1     1
##  3782  3783  3789  3793  3798  3800  3803  3806  3808  3809  3819  3821  3822
##     2     1     1     2     1     1     1     2     1     2     1     1     3
##  3823  3824  3826  3827  3830  3831  3832  3834  3835  3838  3841  3842  3847
##     1     1     1     1     1     2     1     3     3     1     1     3     1
##  3850  3851  3852  3853  3854  3856  3857  3858  3859  3866  3867  3868  3871
##     1     1     1     1     1     3     1     1     1     1     1     1     2
##  3877  3879  3881  3884  3885  3886  3887  3891  3892  3893  3894  3895  3897
##     1     1     1     1     1     1     2     1     1     1     1     1     1
##  3898  3899  3901  3904  3906  3908  3910  3914  3922  3923  3926  3931  3940
##     1     3     1     2     1     1     3     1     2     1     1     2     3
##  3941  3942  3950  3955  3962  3973  4002  4009  4017  4023  4027  4052  4058
##     1     1     3     3     1     1     1     1     3     3     3     3     3
```

```
##  4076  4079  4089  4090  4091  4093  4102  4104  4105  4107  4108  4110  4112
##     3     1     3     1     1     1     1     1     1     1     2     1     1
##  4116  4124  4125  4128  4130  4133  4134  4136  4142  4146  4154  4157  4161
##     1     2     1     3     1     3     2     2     1     2     3     3     1
##  4163  4165  4166  4174  4175  4179  4181  4183  4185  4188  4191  4192  4193
##     1     1     2     2     3     2     2     2     2     3     3     3     1
##  4195  4198  4204  4211  4213  4216  4217  4231  4235  4242  4243  4254  4255
##     1     1     3     2     1     3     2     2     2     3     1     1     1
##  4265  4268  4273  4277  4279  4283  4284  4286  4287  4289  4295  4298  4301
##     2     1     1     2     3     1     1     2     2     1     2     1     2
##  4302  4308  4314  4318  4319  4321  4325  4330  4333  4334  4336  4341  4347
##     1     2     2     1     2     2     1     2     2     1     2     1     2
##  4349  4351  4355  4356  4359  4366  4367  4373  4381  4387  4388  4389  4390
##     2     2     2     2     3     2     2     1     2     1     1     1     1
##  4394  4395  4396  4398  4400  4404  4407  4408  4420  4421  4422  4427  4435
##     3     2     1     1     1     2     1     3     1     1     2     2     2
##  4438  4443  4447  4453  4459  4460  4466  4472  4475  4485  4499  4501  4502
##     1     2     2     2     2     1     3     1     1     1     1     2     1
##  4506  4507  4511  4512  4520  4521  4522  4525  4532  4534  4535  4544  4549
##     1     1     1     1     3     1     1     1     1     2     3     1     1
##  4551  4558  4560  4565  4571  4572  4583  4604  4620  4624  4646  4648  4649
##     1     3     2     3     1     2     3     1     1     1     1     1     1
##  4661  4667  4670  4677  4679  4682  4683  4685  4690  4692  4695  4699  4702
##     3     3     2     3     1     3     3     2     3     1     1     3     3
##  4709  4718  4719  4721  4722  4730  4732  4735  4745  4747  4750  4759  4763
##     1     1     3     2     2     3     1     1     3     1     1     3     3
##  4765  4772  4781  4785  4788  4793  4796  4799  4803  4807  4819  4826  4830
##     3     3     1     3     3     3     1     3     3     3     3     1     1
##  4832  4834  4837  4838  4839  4844  4845  4846  4847  4849  4850  4854  4861
##     1     1     1     1     1     3     1     2     2     1     3     3     1
##  4862  4863  4866  4869  4880  4883  4884  4886  4890  4892  4893  4896  4897
##     1     2     2     1     2     3     2     1     1     1     1     3     1
##  4901  4906  4910  4914  4917  4922  4924  4930  4933  4936  4937  4938  4941
##     1     1     1     1     1     1     3     1     1     1     3     1     1
##  4945  4949  4954  4956  4960  4964  4968  4970  4973  4976  4978  4980  4985
##     1     1     2     1     3     1     3     1     2     1     3     1     3
##  4987  4988  4989  4991  4997  4999  5001  5003  5004  5005  5006  5008  5011
##     3     2     3     2     3     3     1     2     1     1     3     1     3
##  5012  5013  5014  5015  5016  5017  5019  5020  5022  5023  5024  5027  5030
##     1     2     1     3     1     3     3     3     2     1     3     1     2
##  5031  5033  5034  5040  5044  5045  5047  5048  5049  5050  5052  5054  5055
##     2     2     3     3     3     3     2     3     3     1     1     3     3
##  5056  5058  5059  5063  5067  5068  5069  5070  5071  5078  5079  5080  5081
##     3     2     3     2     3     3     2     1     3     3     3     2     2
##  5082  5083  5084  5085  5087  5090  5095  5097  5098  5099  5102  5104  5105
##     3     3     3     3     2     3     1     3     2     1     2     3     3
##  5108  5112  5117  5123  5125  5126  5127  5130  5135  5138  5142  5147  5151
##     1     1     1     3     1     1     3     1     1     3     3     3     3
##  5152  5153  5155  5156  5158  5163  5165  5166  5168  5171  5176  5177  5179
##     1     1     1     1     1     1     3     1     1     1     3     1     1
##  5180  5183  5184  5187  5188  5189  5192  5195  5197  5200  5201  5202  5203
##     3     3     3     1     1     2     1     3     1     1     1     3     1
```

```
##  5205  5206  5207  5208  5210  5212  5213  5215  5217  5218  5219  5220  5221
##     1     3     3     3     3     3     3     3     3     2     3     3     3
##  5222  5223  5225  5227  5228  5230  5231  5232  5234  5235  5236  5237  5238
##     3     3     3     3     1     1     1     1     3     3     3     3     3
##  5240  5241  5242  5243  5244  5246  5247  5248  5250  5251  5252  5253  5254
##     3     3     3     2     2     3     3     3     3     3     3     3     3
##  5256  5258  5259  5260  5262  5263  5266  5267  5268  5271  5275  5276  5277
##     3     3     1     3     3     3     3     3     3     3     3     1     1
##  5278  5279  5282  5283  5287  5288  5289  5309  5329  5330  5333  5334  5355
##     3     1     3     3     3     1     1     3     3     3     1     3     1
##  5368  5369  5374  5376  5378  5382  5387  5393  5394  5396  5397  5399  5405
##     3     2     3     2     3     1     2     1     2     1     3     1     3
##  5408  5410  5412  5414  5415  5417  5428  5430  5435  5439  5444  5446  5453
##     3     2     1     3     1     1     1     1     3     2     1     1     3
##  5454  5455  5456  5457  5458  5459  5460  5462  5463  5468  5471  5473  5484
##     3     3     1     3     3     3     3     1     2     3     3     3     3
##  5488  5490  5492  5499  5500  5501  5504  5506  5509  5510  5512  5517  5523
##     1     1     3     1     3     1     1     1     1     3     3     2     1
##  5524  5526  5527  5528  5530  5531  5532  5533  5537  5538  5540  5543  5546
##     1     1     3     1     3     1     1     3     3     1     1     1     3
##  5547  5550  5551  5552  5554  5556  5557  5558  5560  5562  5564  5565  5566
##     3     2     3     3     1     1     1     3     1     1     3     3     3
##  5567  5568  5569  5570  5574  5582  5584  5585  5586  5588  5590  5591  5593
##     2     1     1     3     3     1     1     2     3     2     2     2     1
##  5600  5604  5609  5611  5612  5613  5616  5618  5621  5622  5624  5627  5628
##     3     2     1     2     1     2     2     3     1     3     1     2     1
##  5629  5630  5631  5633  5637  5638  5639  5641  5643  5647  5648  5649  5652
##     3     2     2     1     3     3     1     2     3     1     3     1     1
##  5653  5656  5659  5662  5664  5665  5666  5667  5670  5671  5672  5673  5677
##     2     3     2     3     1     3     1     2     1     1     2     3     2
##  5681  5685  5692  5706  5708  5711  5715  5716  5718  5724  5728  5731  5741
##     2     1     1     3     2     2     3     2     2     1     1     2     3
##  5745  5746  5764  5765  5767  5768  5772  5773  5777  5778  5780  5782  5786
##     1     1     2     1     3     3     1     1     3     1     1     1     1
##  5790  5794  5802  5803  5805  5809  5810  5814  5821  5823  5824  5828  5833
##     1     1     3     1     1     1     3     1     1     2     1     1     1
##  5843  5844  5852  5854  5857  5860  5872  5884  5886  5889  5944  5946  5949
##     1     3     1     1     1     3     3     1     2     1     1     3     1
##  5951  5954  5967  5968  5975  5982  5983  5989  5996  6002  6012  6018  6022
##     1     1     1     1     1     1     3     2     1     1     2     1     1
##  6026  6027  6030  6035  6036  6053  6054  6055  6062  6070  6082  6094  6095
##     2     1     3     2     2     2     2     1     3     1     1     2     1
##  6139  6151  6173  6214  6225  6234  6243  6248  6255  6259  6264  6268  6269
##     3     3     1     3     3     2     1     1     1     3     2     2     3
##  6277  6282  6283  6288  6295  6302  6310  6312  6313  6316  6326  6333  6338
##     2     1     3     1     2     3     1     1     2     3     1     1     1
##  6356  6358  6364  6366  6369  6374  6396  6401  6402  6422  6465  6486  6508
##     1     1     1     1     1     1     1     1     2     3     1     1     1
##  6514  6558  6570  6579  6581  6600  6642  6651  6657  6662  6670  6671  6673
##     1     1     1     3     1     2     1     1     3     1     1     3     2
##  6678  6683  6684  6688  6690  6692  6695  6697  6699  6701  6708  6709  6711
##     2     1     1     1     2     1     2     1     3     3     3     1     3
```

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##  6714  6720  6723  6725  6726  6728  6729  6732  6733  6735  6741  6742  6745
##     1     1     2     2     3     1     1     1     3     1     1     1     3
##  6747  6757  6766  6768  6772  6787  6800  6803  6815  6817  6833  6865  6906
##     1     1     2     1     1     1     1     1     2     1     1     1     1
##  6907  6914  6915  6918  6928  6933  6934  6936  6937  6943  6944  6945  6953
##     1     2     3     1     2     1     1     3     2     1     2     3     2
##  6965  6975  6977  6981  6988  6995  7000  7007  7009  7011  7014  7021  7027
##     1     3     3     1     3     3     1     3     3     3     3     1     2
##  7029  7031  7033  7046  7052  7055  7074  7076  7079  7086  7088  7090  7091
##     3     3     2     1     1     1     2     1     3     3     3     3     1
##  7107  7108  7109  7116  7117  7118  7139  7151  7152  7154  7158  7162  7163
##     2     2     1     1     1     1     1     1     1     2     1     1     1
##  7172  7176  7178  7180  7183  7187  7189  7190  7191  7192  7193  7196  7197
##     1     1     3     1     1     1     2     1     1     1     1     1     1
##  7201  7202  7205  7206  7210  7216  7217  7220  7222  7223  7224  7225  7226
##     1     1     1     2     1     1     1     1     1     3     1     1     3
##  7228  7237  7238  7239  7241  7242  7245  7248  7249  7251  7255  7261  7264
##     1     1     2     1     1     1     1     1     1     1     1     2     1
##  7267  7270  7271  7277  7278  7279  7280  7283  7285  7288  7294  7300  7304
##     2     1     2     1     1     1     1     1     1     3     3     3     2
##  7307  7309  7311  7313  7316  7320  7321  7322  7331  7332  7338  7350  7354
##     1     3     2     1     1     1     1     1     3     1     3     1     1
##  7358  7360  7365  7367  7368  7373  7378  7380  7382  7383  7386  7387  7393
##     1     1     1     1     1     3     3     2     1     1     1     1     1
##  7394  7398  7399  7401  7402  7405  7406  7409  7414  7416  7417  7419  7421
##     2     1     1     1     1     1     1     2     1     1     1     1     1
##  7423  7427  7431  7432  7434  7435  7436  7437  7438  7446  7450  7452  7454
##     1     3     1     1     2     1     1     1     1     1     1     1     1
##  7458  7461  7464  7469  7472  7474  7475  7477  7481  7482  7483  7489  7491
##     1     2     1     1     1     1     3     1     2     1     3     1     1
##  7492  7493  7497  7498  7499  7500  7502  7505  7506  7507  7508  7513  7515
##     1     1     1     1     1     1     2     1     3     3     1     2     1
##  7516  7517  7520  7522  7524  7526  7527  7528  7532  7540  7543  7554  7568
##     1     1     1     1     1     1     1     1     1     1     1     1     1
##  7572  7578  7584  7589  7590  7593  7598  7603  7608  7612  7613  7619  7621
##     1     1     3     1     1     1     1     1     1     2     1     1     1
##  7623  7625  7627  7630  7638  7639  7641  7643  7646  7648  7651  7657  7658
##     1     1     1     3     1     1     1     1     1     1     1     1     1
##  7659  7660  7661  7662  7666  7667  7669  7670  7673  7674  7682  7694  7696
##     1     1     1     1     1     1     3     1     1     1     1     2     3
##  7697  7705  7708  7712  7722  7724  7726  7733  7738  7740  7746  7749  7750
##     3     3     2     2     3     3     3     1     3     3     3     3     2
##  7752  7757  7769  7770  7777  7783  7788  7811  7824  7832  7835  7837  7839
##     3     3     2     3     3     3     3     3     3     1     1     2     1
##  7840  7845  7846  7851  7857  7859  7867  7870  7871  7876  7878  7881  7883
##     1     1     1     2     1     3     3     1     2     1     3     2     3
##  7885  7891  7893  7895  7896  7898  7899  7900  7904  7906  7911  7912  7914
##     1     3     1     1     1     1     1     3     2     2     3     3     3
##  7920  7921  7923  7927  7929  7947  7953  7973  7974  7975  7981  7984  7986
##     2     3     2     2     2     1     3     3     2     2     1     1     1
##  7991  8010  8053  8054  8059  8064  8075  8077  8082  8088  8093  8121  8133
##     1     1     2     1     1     3     3     1     3     1     1     1     1
```

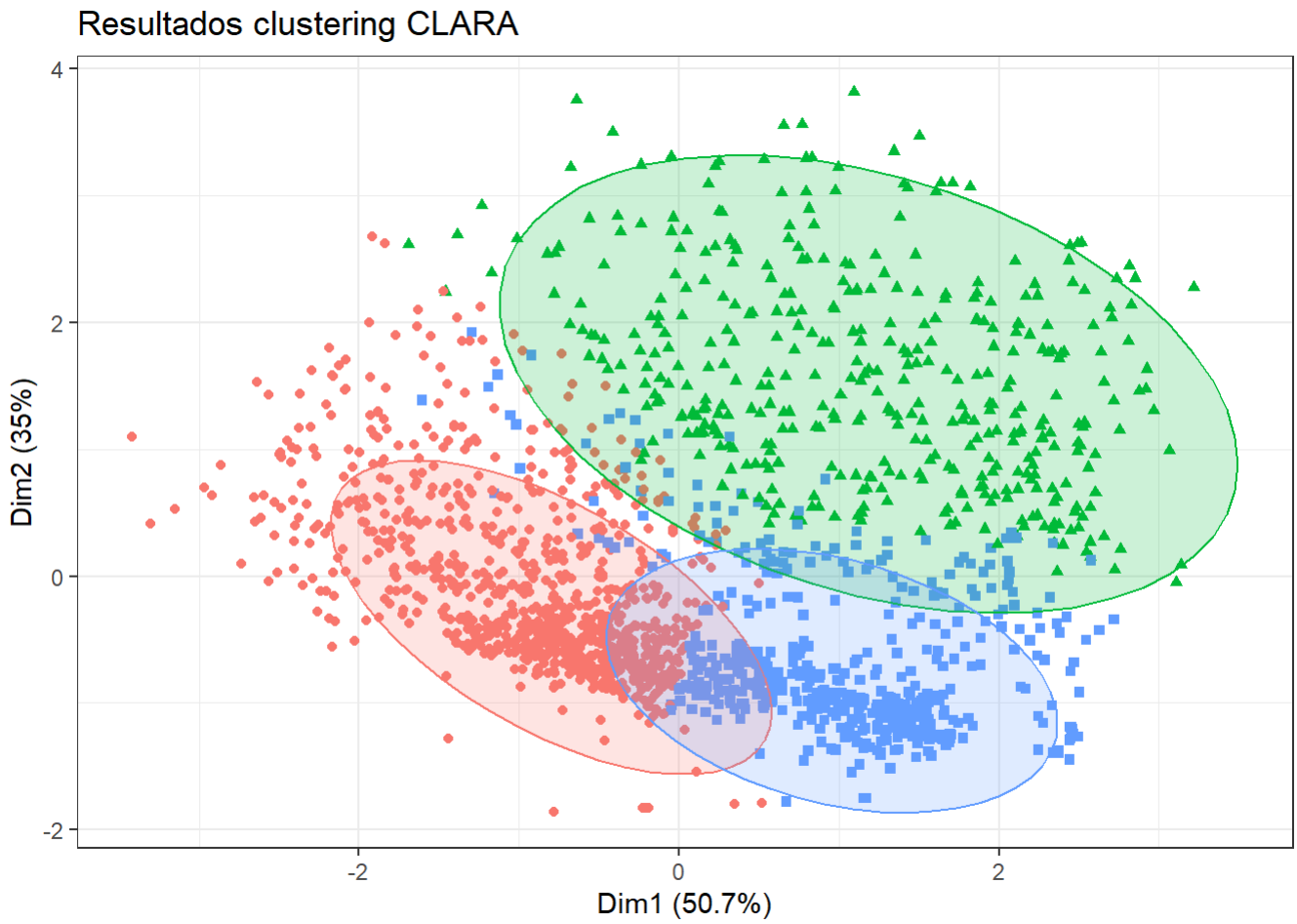
```
##  8140  8142  8158  8162  8192  8194  8202  8204  8205  8213  8216  8220  8223
##     1     1     3     1     3     1     3     1     1     1     1     1     2
##  8227  8238  8246  8255  8257  8262  8263  8272  8277  8278  8279  8284  8287
##     3     1     1     1     1     1     1     3     1     1     1     1     2
##  8290  8323  8330  8333  8335  8341  8352  8367  8374  8378  8379  8380  8389
##     1     1     3     1     1     1     1     3     1     3     1     1     1
##  8395  8403  8404  8406  8414  8424  8430  8431  8433  8444  8459  8460  8464
##     1     2     1     1     1     2     1     1     1     1     1     1     1
##  8474  8480  8482  8486  8491  8493  8507  8508  8520  8532  8563  8565  8566
##     1     3     2     2     1     1     3     1     1     2     3     2     3
##  8568  8569  8571  8575  8578  8579  8580  8582  8583  8585  8589  8590  8591
##     1     1     1     3     1     1     2     1     1     3     3     1     1
##  8592  8593  8594  8595  8596  8597  8598  8600  8602  8603  8605  8607  8614
##     3     2     1     3     1     1     1     1     1     3     1     1     1
##  8615  8618  8621  8623  8624  8626  8628  8632  8634  8636  8637  8638  8639
##     2     2     3     1     1     1     1     1     1     1     1     1     3
##  8640  8649  8658  8683  8699  8715  8716  8718  8735  8739  8742  8743  8746
##     1     1     2     1     1     3     1     3     1     1     1     1     1
##  8751  8755  8758  8763  8769  8773  8776  8777  8778  8788  8789  8791  8799
##     1     3     3     1     3     1     1     3     2     1     2     1     2
##  8802  8803  8804  8808  8812  8817  8819  8827  8828  8830  8831  8834  8839
##     1     1     1     1     3     1     1     1     3     2     1     2     3
##  8843  8844  8846  8849  8852  8854  8856  8858  8859  8862  8865  8866  8869
##     1     1     1     1     1     1     3     3     2     1     1     1     1
##  8870  8871  8873  8876  8882  8883  8884  8885  8886  8891  8892  8898  8899
##     1     2     1     2     2     1     2     2     1     1     3     3     1
##  8900  8905  8911  8912  8913  8914  8915  8917  8920  8921  8925  8926  8928
##     1     1     1     1     1     1     1     2     2     1     2     3     1
##  8930  8935  8936  8938  8939  8944  8947  8948  8951  8957  8968  8971  8973
##     3     2     1     1     2     1     2     3     3     1     1     1     3
##  8974  8992  8996  8997  8999  9015  9018  9023  9024  9033  9051  9062  9065
##     1     1     1     3     1     3     1     1     3     1     3     2     1
##  9082  9092  9095  9099  9106  9109  9113  9114  9127  9128  9130  9131  9134
##     1     1     1     3     1     2     3     2     1     1     2     1     1
##  9135  9137  9144  9147  9149  9151  9155  9164  9166  9169  9170  9172  9177
##     2     1     3     2     3     1     1     2     2     1     1     3     2
##  9183  9186  9187  9190  9192  9193  9196  9198  9199  9202  9208  9210  9212
##     1     1     2     1     1     2     1     1     3     2     1     1     2
##  9214  9220  9223  9224  9228  9230  9231  9233  9235  9239  9246  9248  9251
##     1     1     1     3     1     2     1     2     3     1     1     2     1
##  9253  9254  9263  9266  9267  9270  9272  9276  9277  9281  9285  9287  9294
##     1     1     1     1     3     3     2     1     1     3     2     2     2
##  9298  9302  9305  9306  9311  9315  9316  9317  9322  9323  9324  9325  9327
##     1     1     1     1     1     1     2     2     2     2     2     2     3
##  9328  9329  9330  9331  9333  9334  9336  9338  9341  9343  9346  9351  9352
##     1     3     3     1     1     2     1     2     2     2     1     1     2
##  9356  9360  9361  9364  9367  9369  9375  9376  9378  9388  9399  9400  9401
##     3     1     3     1     1     1     1     1     2     1     2     1     3
##  9408  9413  9415  9416  9418  9423  9426  9428  9434  9435  9441  9442  9443
##     1     2     2     2     1     1     3     1     1     1     1     2     3
##  9444  9447  9448  9459  9461  9463  9465  9467  9469  9474  9482  9485  9486
##     1     2     2     1     1     3     1     1     1     1     2     1     2
```

```
##  9488  9490  9491  9492  9493  9494  9495  9496  9498  9499  9502  9505  9511
##     1     1     2     2     1     2     1     2     2     2     3     1     2
##  9512  9514  9517  9530  9535  9539  9545  9548  9550  9551  9557  9562  9564
##     2     3     1     1     1     2     1     3     2     1     1     1     3
##  9568  9569  9574  9576  9585  9589  9590  9592  9603  9604  9612  9617  9644
##     3     3     3     1     1     1     1     1     2     1     1     1     1
##  9656  9666  9668  9681  9692  9703  9707  9709  9715  9718  9719  9726  9732
##     1     1     1     1     3     3     3     1     2     3     2     3     1
##  9735  9738  9748  9755  9759  9763  9766  9768  9776  9779  9780  9788  9792
##     3     1     2     1     3     1     1     1     1     1     2     3     1
##  9795  9797  9802  9803  9814  9815  9818  9826  9827  9829  9830  9836  9837
##     3     3     3     1     3     2     1     1     3     1     3     1     3
##  9838  9840  9842  9844  9845  9846  9848  9851  9853  9854  9856  9857  9859
##     1     1     2     2     3     1     3     2     3     1     1     1     3
##  9861  9864  9865  9868  9869  9870  9874  9879  9883  9884  9885  9888  9889
##     1     1     3     1     2     3     2     3     1     3     2     1     1
##  9894  9898  9899  9903  9910  9914  9920  9922  9923  9924  9925  9926  9928
##     1     3     3     1     3     2     1     2     2     1     3     1     1
##  9929  9931  9932  9935  9937  9938  9942  9950  9954  9957  9958  9959  9960
##     3     1     1     1     3     3     1     2     3     1     1     3     3
##  9961  9962  9964  9966  9967  9974  9978  9980  9981  9986  9993 10002 10008
##     3     1     2     1     1     2     3     2     3     1     3     1     2
```

```
table(clara_clusters$clustering)
```

```
##
##    1    2    3
## 1349  458  702
```

```
fviz_cluster(object = clara_clusters, ellipse.type = "t", geom = "point",
             pointsize = 1.5) +  theme_bw() +
  labs(title = "Resultados clustering CLARA") +
  theme(legend.position = "none")
```


Resultados clustering CLARA
4
2
0
-2
Dim2 (35%)
-2
0
2
Dim1 (50.7%)