

# Study of vegetable oils of sacha inchi (*Plukenetia huayllabambana*), *sesamum indicum* and peanuts (*Arachis hypogaea*) and their influence on making vegetable sausages type “Frankfurt” considering bromatological and organoleptic characteristics

Juan Alejandro Neira Mosquera<sup>1</sup>, Oliver Frank Menéndez Viteri<sup>2</sup>, Julio Alejandro Ullón Arcia<sup>3</sup>, Sungey Naynee Sánchez Llaguno<sup>4</sup>

<sup>1,2,3</sup>Universidad Técnica Estatal de Quevedo, Docente- investigador/Grupo de Investigación Agroalimentación/Facultad Ciencias de la Ingeniería, Quevedo, Ecuador

<sup>4</sup>Universidad de las Fuerzas Armadas ESPE, Docente- investigador/Grupo de Investigación Agroalimentación, Quevedo, Ecuador

Email: neiramosquera@uteq.edu.ec

## Abstract

The present research was carried out as part of the “FOCICYT PROJECT PFOC 5- 28-2017 U.T.E.Q” and obtained oils from sacha inchi, sesame and peanut oilseeds extracted by cold pressing. Subsequently, the application of these oils in the elaboration of “Frankfurt” type vegetable sausages was studied, including the application of vegetable proteins from Quinoa and Soybean. The research was carried out using an experimental design with a factorial model (AxB). Considering the fatty acid profile, sacha inchi and sesame oils showed ideal characteristics for both saturated and poly-unsaturated, and in monounsaturated, the optimal estimation of the results was notable in peanut oil. As for the proximate variables, sesame and peanut oils obtained notable scores in pH and peroxide index, while in acidity and relative density, all oils had outstanding values. For the Frankfurt-type vegetable sausage process, the best results were obtained for protein, fat, moisture and pH in the treatments: Sesame + Soybean, Sacha inchi + Quinoa, Sesame + Quinoa and Sesame + Soybean, placing them within the national and international standards, for blanched sausages. For the organoleptic study of the product, the treatments with the best acceptance were: Sesame + Quinoa, Peanut + Quinoa and Peanut + Soybean. Considering yields, the sausages made by including quinoa protein had a higher value (83.41 %).

**Keywords:** oilseeds, oil, vegetable proteins, sausage.

## INTRODUCTION

In search of improving the quality of life of society, plants serve as a source of food, medicinal products and energy; in this sense, raw materials of plant origin have become a primary factor and play a fundamental role in the development of today’s society (Carriel, 2014). Vegetable oil is an organic compound obtained from seeds and plant parts as a source of energy (Knothe, 2005). The chemical composition of vegetable oils corresponds to a mixture of 95% triglycerides and 5% free fatty acids, sterols, waxes and others (Narvaez, 2007).

If this mixture is solid or of pasty consistency at room temperature (20o C), it is a “fat,” whereas, if it is liquid at room temperature, it is an “oil” (Ruiz, 2006).

Address for correspondence: Juan Alejandro Neira Mosquera  
Docente- investigador/Grupo de Investigación Agroalimentación/Facultad  
Ciencias de la Ingeniería, Quevedo, Ecuador  
Email: neiramosquera@uteq.edu.ec

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

### Access this article online

#### Quick Response Code:



Website:  
www.pnrjournal.com

DOI:  
10.47750/pnr.2022.13.03.091

For reprints contact: pnrjournal@gmail.com

How to cite this article: Juan Alejandro Neira Mosquera, Oliver Frank Menéndez Viteri, Julio Alejandro Ullón Arcia, Sungey Naynee Sánchez Llaguno, Study of vegetable oils of sacha inchi (*Plukenetia huayllabambana*), *sesamum indicum* and peanuts (*Arachis hypogaea*) and their influence on making vegetable sausages type “Frankfurt” considering bromatological and organoleptic characteristics, J PHARM NEGATIVE RESULTS 2022;13:623-627.

The alteration of the lipid profile is a risk factor for suffering cardiovascular and cerebrovascular diseases, and trans and saturated fatty acids are considered risk factors for some types of cancer (Cabezas, 2015). An alternative to improve the balance of fatty acids is incorporating vegetable oils in preparing meat products (Rueda Lugo et al., 2006). Vegetable oils are cholesterol-free and have a high quantity of monounsaturated fatty acids (Rivera Ruiz, 2012). In order to reduce production costs and the use of animal protein, vegetable flours such as starch, corn, Soybean and Quinoa derivatives have been used as fillers, binders, diluents and extenders (Hleap Zapata et al., 2017). Taking into account these considerations, the present research proposes the elaboration of a vegetable sausage, implementing sacha inchi, sesame, peanut and colloidal protein complexes such as Quinoa and Soybean oils, evaluating bromatological and organoleptic parameters, allowing to know the properties and benefits of its consumption through its transformation and incentive to the industrialization and commercialization of this product.

## METHODOLOGY

### Materials and methods

Extraction of oil from oilseeds by mechanical pressing for the production of “Frankfurter” type vegetable sausage.

Cold pressing was used as a physical extraction method to obtain the oils, where the humidity of the seeds used should be between 5 - 7 %.

For the extraction, a hydraulic press was used, with a

pressure of 246 - 250 Bar, and the oil was filtered and later bottled. The weight of the raw materials was as follows: sacha inchi (41.2 Kg), sesame (13.64 Kg) and peanut (10 Kg), to later find yields employing material balance. For the preparation of the Frankfurt-type vegetable sausage, the emulsion was made in a cutter in which oilseed oils (10 %), vegetable proteins (62.29 %), flours (7.94 %), ice (19.77 %) and additives (3.47 %) were used, using a total of 1.5 kg of raw material in the process. After stuffing, the sausages were subjected to a scalding process with water at a temperature of 75 oC for 20 minutes until reaching an internal temperature of 75 - 80 oC.

Organoleptic evaluation carried out on “Frankfurt” type vegetable sausages.

To carry out this evaluation, using the ISO 6564:1985 standard, a practical analysis was carried out using a 5-point hedonic scale: 1: I dislike it very much, 2: I dislike it slightly, 3: I am indifferent, 4: I like it slightly and 5: I like it very much, for the attributes appearance, smell, taste, texture and residual sensation, in a panel of 6 people.

### Statistical analysis of results

A DBCA ANOVA with AxB factorial arrangement with three replications was applied to study the elaboration of “Frankfurt” type vegetable sausages through the use of oils, together with the addition of vegetable proteins (Table 1). The statistical analysis of the results, both lipid profile, proximal, bromatological and organoleptic, was carried out in the statistical software SPSS InfoStat and Statistica.

Table 1. Factors involved in the study of the “Frankfurter” type vegetable sausage production process.

**Table 1.** Factors involved in the study of the process of making vegetable sausages type “Frankfurt”.

Study factors	Symbology	Description
Factor A: Oilseed oil	a <sub>0</sub>	<i>Plukenetia huayllabambana</i>
	a <sub>1</sub>	<i>Sesamum indicum</i>
	a <sub>2</sub>	<i>Arachis hypogaea</i>
Factor B: Type of vegetable protein	b <sub>0</sub>	<i>Chenopodium quinoa</i>
	b <sub>1</sub>	<i>Glycine max</i>

Source: Menendez, O; Ullón, A (2020).

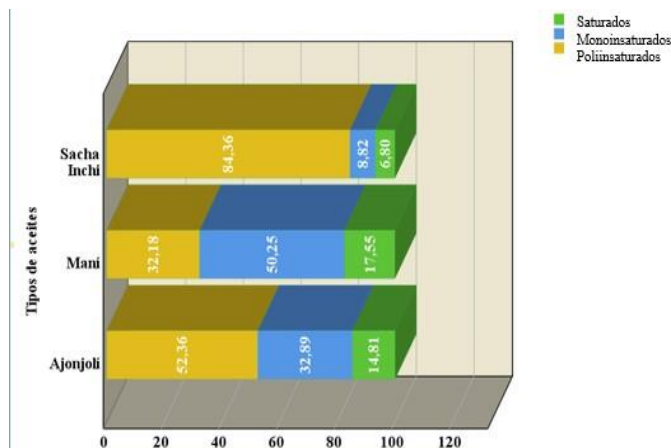
## RESULTS AND DISCUSSION

### Fatty acid profile and proximate analysis of vegetable oils

According to (Arfini & Antonioli, 2013), sacha inchi oil shows an unsaturated level of 91.6 %, omega-3 of 45.2 %, and omega-6 of 36.8 %, for ajonjli (Acevedo, Marrugo, & Montero, 2013) show a linoleic acid content of (35 to 41% of total oil), furthermore (ZAVALA GILER & CASTILLO FARFAN, 2007) indicate that this oil contains 85 % unsaturated fatty acids. Considering the content of saturated

fatty acids (Figure 1), peanut seed oil presented a higher percentage in its composition (17.55 %), unlike sesame (14.81 %) and sacha inchi (6.80 %), which showed a lower concentration. As for poly-unsaturated, sacha inchi oil (84.36 %) showed a higher estimate than sesame oil (52.36 %) and peanut oil (32.18 %). And in monounsaturated, peanut oil (50.25 %) denoted a higher percentage compared to sesame (32.89 %) and sacha inchi (8.82 %), showing that its components of the fat fraction are unsaturated, such as (oleic 50 % and linoleic 25 %) according to (Pereira, 2011). Consistent with the described (Ramos Escudero, Ponce

Dayr, Barnett Mendoza, Celi Saavedra, & Ramos Escudero, 2016) in their research of Sacha inchi oil fatty acid profile, indicate values for saturated fatty acids around 7.04 % and polyunsaturated over 82.90 %, while, for peanut and sesame oils, Mexican (NMX-F-027-1985, 1985) (NMX-F-002-1985, 1985) and Ecuadorian (NTE INEN 28:1973, 1973) (NTE INEN 8:2012, 2012) standards do not indicate general valuations.



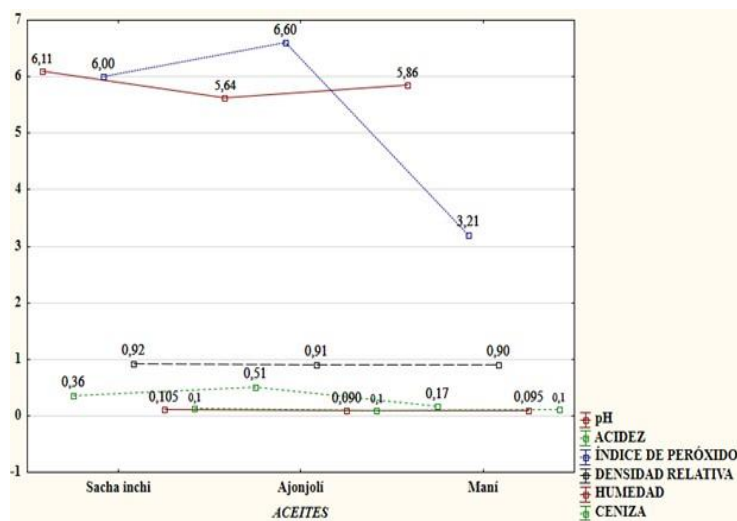
**Figure 1.** Fatty acid profile in oilseed oils extracted by mechanical pressing.

Source: Menendez, O; Ullón, A (2020).

Proximal analysis of vegetable oils

Cefla Miranda (2015) indicates that oil extraction methods are used at industrial, laboratory and pilot scales, where depending on the extraction methods for Tabio García et al., (2017), using mechanical extraction provides benefits, such as optional refining and a protein cake. When estimating the results of (pH, acidity, and peroxide index) carried out on the oils (Figure 2), considering the pH content, sacha inchi oil (6.11) denoted higher concentration, unlike peanut (5.86) and sesame (5.64), where the results were lower. While in the acidity, the sesame oil (0.51 % oleic) and the peanut oil (0.17 % oleic) showed higher values, showing adherence to that described by (ZAVALA GILER & CASTILLO FARFAN, 2007) where sesame oil contains acidity between 0.2 % and 0.65 % of oleic, according to the results of the study. 65 % oleic, according to Mexican standards (NMX-F-027- 1985, 1985) (NMX-F-002-1985, 1985) for pure edible peanut and sesame oil, the values for these variables are maximum (0.05 % oleic), while Ecuadorian standards (NTE INEN 28:1973, 1973) and (NTE INEN 8:2012, 2012) establish 0.2 % as maximum. Regarding the peroxide index, the highest content is demonstrated in sesame oil (6.60 meq O<sub>2</sub> /Kg) and sacha inchi (6.00 meqO<sub>2</sub> /Kg) and the lowest, in Peanut oil (3.21 meq O<sub>2</sub> /Kg), according to the Ecuadorian standard (NTE INEN 8:2012, 2012) for sesame oil and Peruvian (NTP 151.400, 2009) for sacha inchi, the maximum range of peroxides for these, should be 10.00 meq O<sub>2</sub> /kg of oil, and the Mexican (NMX-F-027-1985, 1985) for peanut oil, a range of meq O<sub>2</sub> /kg of 0-2, and as far as relative density is concerned, sacha inchi oil (0.92 g/cm<sup>3</sup> )

expresses higher results, compared to sesame oil (0.91 g/cm<sup>3</sup> ) and peanut (0.90 g/cm<sup>3</sup> ), which is within the ranges stipulated by the Peruvian (NTP 151.400, 2009) (0.926 - 0.931) for sacha inchi and Ecuadorian (NTE INEN 28:1973, 1973) (0.91 - 0.915) and (NTE INEN 8:2012, 2012) sesame (0.916 - 0.921) standards for peanuts. It should be noted that the variables, moisture and ash, did not show significant differences.



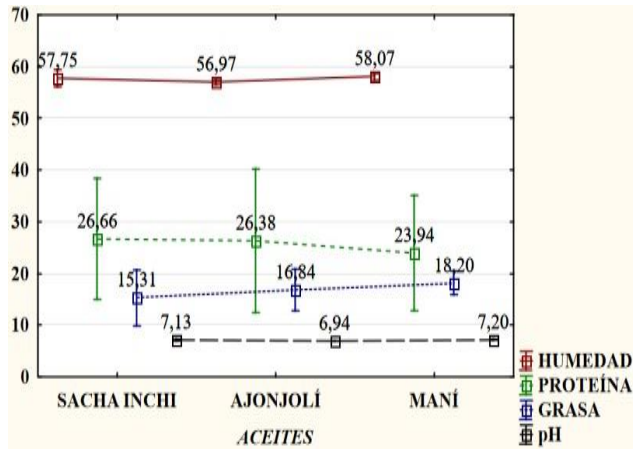
**Figure 2.** Tukey significance test (p < 0.05) for proximal analysis, performed on oilseed oils.

Source: Menendez, O; Ullón, A (2020).

Bromatological study.

The “Frankfurt” type sausage, according to (Guamán Cayambe, 2011) can have added starches and proteins (Soybean, Quinoa), where (Peña et al., 2015) describe that they fulfill technological functions in meat products. According to data interpretation, Tukey tests (p < 0.05), the effect of the study factors (Figure 3) and (Figure 4) is significant in the content of bromatological variables, jointly with their interactive effect (Table 2). Consequently, the peanut oil sausages showed higher values in the variables moisture (58.07 %), fat (18.2 %) and pH (7.20), and for those with sacha inchi (26.66 %), the protein results were higher than those with sesame oil (26.38 %) and peanut (23.94 %). The results for moisture (57.75 and 56.97 %), fat (15.31 and 16.84 %) and pH (7.13 and 6.94) were favorable for the sausages where sacha inchi and sesame oil were used. Regarding the type of protein used, soy protein sausages, the effect was significant in all the study variables: moisture (58.03 %), protein (36.31 %), fat (20.21 %) and pH (7.17), compared to those with quinoa protein: moisture (57.17 %), protein (15.0 %), fat (13.36 %) and pH (7.01). When estimating interaction values, the treatments (Sacha inchi + Quinoa) showed optimal results in moisture and fat (56.38 % and 10.5 %) and (Sesame + Soybean) also in protein and pH (38.44 % and 6.98) where the Ecuadorian standard (NTE INEN 1338:2012, 2012) for protein and fat in sausages, establishes ranges (greater than or equal to 12 % protein) and (less than or equal to 25 % referring to fat) and for pH and

moisture, limits less than 65 % and less than or equal to 6.2, while the Mexican (NMX-F-065-1984, 1984) and Nicaraguan (NTON 03 103-16, 2017), the ranges for protein, fat and moisture in sausages are as follows: protein (> 9.55), fat (max 25-30 %) and moisture (max 70 - 75 %). For the authors (Palacios & Loyola, 2011) the results were (21.88 %) protein and (12.70 %) fat and (Hleap Zapata, Burbano Portillo, & Mora Vera, 2017) protein (47.47 - 52.49 %) and fat (27.82 - 31.73 %). For Valero Gaspar et al., (2009) pH ranges from (5.2 - 7.2).



**Figure 3.** Tukey significance test ( $p < 0.05$ ) for bromatological analysis performed on vegetable sausages type “Frankfurt” Factor A (Oil oil oil).

Source: Menendez, O; Ullón, A (2020).

**Table 2.** Tukey’s significance test for bromatological analysis (Tukey’s significance test for bromatological analysis).

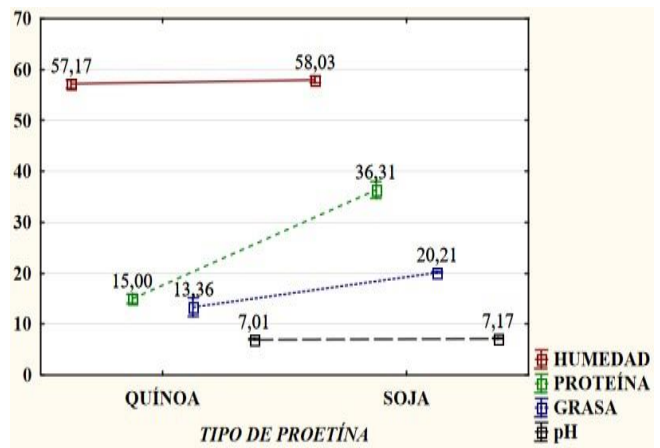
Oilseed oil * Type of vegetable protein	Humidity	Protein	Grease	pH
Sacha inchi + Quinoa	56.38A	16.44C	10.5A	6.99B
Sacha inchi + Soybean	59.12F	38.89E	20.05D	7.27D
Sesame + Quinoa	56.51B	14.31B	13.28B	6.90A
Sesame + Soybean	57.43C	38.44F	20.40F	6.98B
Peanut + Quinoa	58.61E	14.25A	16.22C	7.14C
Peanut + Soybean	57.53D	33.62D	20.19E	7.26D

Source: Menendez, O; Ullón, A (2020).

Interactions involved in the study of vegetable oils from sacha inchi (*Plukenetia huayllabambana*), sesame (*Sesamum indicum*), and peanut (*Arachis hypogaea*) and their influence on the elaboration of “Frankfurt” type vegetable sausages considering bromatological and organoleptic characteristics.

Organoleptic characteristics of “Frankfurter” type vegetable sausages

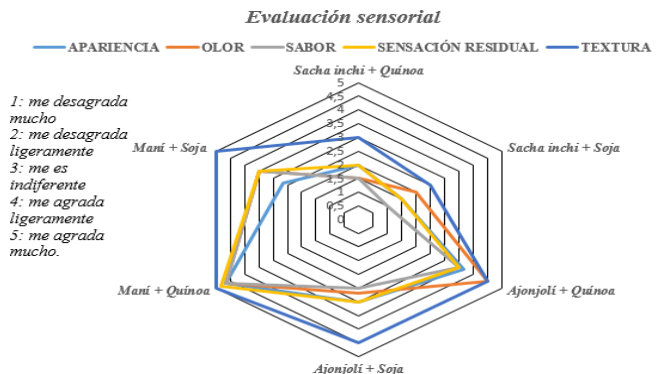
An effective analysis was carried out using a 5-point hedonic scale to evaluate the level of liking of the attributes. The treatments: (Sesame + Quinoa), (Peanut + Quinoa) and (Peanut + Soybean) expressed the best evaluation in terms of odor, flavor, residual sensation and texture, while in appearance, the most relevant treatments were: (Sesame +



**Figure 4.** Tukey significance test ( $p < 0.05$ ) for bromatological analysis performed on vegetable sausages type “Frankfurt” Factor B (Type of vegetable protein).

Source: Menendez, O; Ullón, A (2020).

Quinoa) and (Peanut + Quinoa) (Figure 5).



**Figure 5.** Organoleptic evaluation, in vegetable sausages type “Frankfurt” corresponding to the appearance, smell,

taste, texture and residual sensation.

Source: Menendez, O; Ullón, A (2020).

## CONCLUSION

It is concluded in this research work, when considering bromatological and organoleptic characteristics in the processed sausages, that those with the best evaluation for protein were those belonging to the treatment (sesame + Soybean) with (38.44 %) and for fat (sacha inchi + Quinoa) with a value of 10.5 %, while for moisture and pH, the treatments (sacha inchi + Quinoa) stood out with 56.38 % and (sesame + quinoa), (sesame + soybean) with 6.90 and 6.98, therefore (sesame + quinoa), (peanut + quinoa) and (peanut + soybean) stood out most in the organoleptic evaluation.

## REFERENCES

1. Acevedo, D., Marrugo, Y., & Montero, P. (2013). Evaluación de las propiedades reológicas de pastas de ajonjolí artesanal y tecnificada. *SciELO*, 1(16), 245-251. Obtenido de <http://www.scielo.org.co/pdf/rudca/v16n1/v16n1a28.pdf>
2. Arfani, F., & Antonoli, F. (2013). Sacha Inchi: Investigación sobre las condiciones para el reconocimiento de la indicación geográfica en el Perú (1era ed.). Jr. Moquegua. Obtenido de [https://www.researchgate.net/publication/303851451\\_SACHA\\_INC\\_HI\\_INVESTIGACION\\_SOBRE\\_LAS\\_CONDICIONES\\_PARA\\_EL\\_RECONOCIMIENTO\\_DE\\_LA\\_INDICACION\\_GEOGRAFICA\\_E\\_N\\_EL\\_PERU](https://www.researchgate.net/publication/303851451_SACHA_INC_HI_INVESTIGACION_SOBRE_LAS_CONDICIONES_PARA_EL_RECONOCIMIENTO_DE_LA_INDICACION_GEOGRAFICA_E_N_EL_PERU)
3. Cabezas, C. (2015). Aceites y grasas: efectos en la salud y regulación mundial. Bogotá . Recuperado el 13 de Mayo de 2019, de <http://www.scielo.org.co/pdf/rfmun/v64n4/0120-0011-rfmun-64-04-00761.pdf>.
4. Carriel, D. (2014). Biocombustible para uso en motores diesel. Potencial de la Moringa Oleifera para obtención de biodiesel. Habana. Recuperado el 13 de Mayo de 2019 Cefla Miranda, K. O. (2015). Diseño de una planta para la extracción de aceite vegetal comestible de las semillas de Chía (*Salvia hispanica* L.) mediante prensado. Quito: EPN. Obtenido de <https://bibdigital.epn.edu.ec/bitstream/15000/10365/3/CD-6164.pdf>
5. Guamán Cayambe, R. C. (2011). Utilización de carne de conejo en la elaboración de salchicha tipo Frankfurt. Riobamba: ESPOCH. Obtenido de <http://dspace.esPOCH.edu.ec/bitstream/123456789/2323/1/84T00073.pdf>
6. Hleap Zapata, J. I., Burbano Portillo, M. Y., & Mora Vera, J. M. (2017). Evaluación fisicoquímica y sensorial de salchichas con inclusión de harina de quinoa (*Chenopodium quinoa* W.). *SciELO*(2), 61 - 71.
7. Knothe, G. (2005). *The Biodiesel Handbook*. Illinois. Recuperado el 13 de Mayo de 2019
8. Narváez, P. (2007). *Kinetics of Palm Oil Methanolysis*. Chicago. Recuperado el 13 de Mayo de 2019
9. NMX-F-002-1985. (1985). ALIMENTOS. ACEITE COMESTIBLE PURO DE AJONJOLÍ.
10. México D.F: colpos.mx. Obtenido de <https://www.colpos.mx/bancodenormas/nmexicanas/NMX-F-002-1985.PDF>
11. NMX-F-027-1985. (1985). ALIMENTOS. ACEITE COMESTIBLE PURO DE CACAHUATE.
12. México D.F: colpos.mx. Obtenido de <https://www.colpos.mx/bancodenormas/nmexicanas/NMX-F-027-1985.pdf>
13. NMX-F-065-1984. (1984). ALIMENTOS. SALCHICHAS. ESPECIFICACIONES. México D.F: colpos.mx. Obtenido de <https://www.colpos.mx/bancodenormas/nmexicanas/NMX-F-065-1984.PDF>
14. NTE INEN 1338:2012. (2012). Carne y productos cárnicos. Productos cárnicos crudos, productos cárnicos curados - madurados y productos cárnicos precocidos - cocidos.
15. Requisitos. Quito: normalización.gob.ec. Obtenido de <https://www.normalizacion.gob.ec/buzon/normas/1338-3.pdf>
16. NTE INEN 28:1973. (1973). ACEITE DE MANÍ. REQUISITOS. Quito: normalización.gob.ec. Obtenido de <https://www.normalizacion.gob.ec/buzon/normas/28.pdf>
17. NTE INEN 8:2012. (2012). ACEITE DE AJONJOLÍ. REQUISITOS. Quito: normalización.gob.ec. Obtenido de <https://www.normalizacion.gob.ec/buzon/normas/8-1.pdf>
18. NTON 03 103-16. (2017). Norma técnica obligatoria nicaragüense. Carne y productos carnicos. Embutidos carnicos. Características y especificaciones. Nicaragua: <http://extwprlegs1.fao.org/docs/pdf/nic190903.pdf>
19. NTP 151.400. (2009). Aceite de Sacha Inchi. Lima: INDECOPI. Obtenido de <https://es.slideshare.net/IngridFarman/ntp-aceite-de-sacha-inchi>
20. Palacios, A. C., & Loyola, W. (2011). ELABORACIÓN DE CHORIZO Y SALCHICHA FRANKFURT A PARTIR DE PROTEÍNA DE SOYA (Glycine max). Paute: dspace.ups.edu.ec. Obtenido de <https://dspace.ups.edu.ec/bitstream/123456789/4741/1/UPS-CT001721.pdf>
21. Peña, M., Méndez, O., Guerra, M., & Peña, A. (2015). Desarrollo de productos cárnicos funcionales: Utilización de harina de quinoa. *Semanticscholar*, 1(23), 21-36. Obtenido de <https://pdfs.semanticscholar.org/b51a/da5acb04acb62b3e1a45f2645be16bfe609.pdf>
22. Pereira, G. (2011). Cultivo de maní. Tacuarembó: INIA. Obtenido de <http://www.ainfo.inia.uy/digital/bitstream/item/7594/1/ST-159-275-281.pdf>
23. Ramos Escudero, F., Ponce Dayer, L., Barnett Mendoza, E., Celi Saavedra, L., & Ramos Escudero, M. (2016). Perfil de ácidos grasos de aceite de Sacha inchi (*Plukenetia volubilis*) en comparación con otros aceites vírgenes comestibles. *Latindex*, 101-108. Obtenido de <https://www.aulavirtualusmp.pe/ojs/index.php/rc/article/view/1142/931>
24. Rivera Ruiz, I. N. (2012). Reducción de grasa y alternativas para su sustitución en productos cárnicos emulsionados, una revisión. *sgpwe*, 6(1), 1 - 14.
25. Rueda Lugo, U., González Tenorio, R., & Totosaus, A. (2006). Sustitución de lardo por grasa vegetal en salchichas: incorporación de pasta de aguacate. Efecto de la inhibición del oscurecimiento enzimático sobre el color. *SciELO*, 26(2), 441 - 445.
26. Ruiz, M. (2006). *Bioquímica de los Procesos Metabólicos*. Reverté. Recuperado el 13 de Mayo de 2019
27. Tabio García, D., Díaz Domínguez, Y., Rondón Macías, M., Fernández Santana, E., & Piloto Rodríguez, R. (2017). Extracción de Aceites de origen vegetal. Habana: Research gate.net. Obtenido de [https://www.researchgate.net/publication/317007345\\_Extraccion\\_de\\_aceites\\_de\\_origen\\_vegetal](https://www.researchgate.net/publication/317007345_Extraccion_de_aceites_de_origen_vegetal)
28. Valero Gaspar, T., Del Pozo de la Calle, S., Ruiz Moreno, E., Ávila Torres, J., & Varela
29. Moreiras, G. (2009). *GUÍA NUTRICIONAL DE LA CARNE*. Madrid: FEN. Obtenido de <https://carnimad.es/ficheros/swf/pdf/guiaNutricion.pdf>
30. ZAVALA GILER, F., & CASTILLO FARFAN, F. (2007). *OBTENCION DEL ACEITE VIRGEN DE LA SEMILLA DE AJONJOLI*. Guayaquil. Obtenido de <http://repositorio.ug.edu.ec/bitstream/redug/1647/1/1011.pdf>.