Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(3): 1752-1756

Received: 19-03-2020
Accepted: 21-04-2020

Meena Goswami
College of Veterinary Sciences and AH, DUVASU, Mathura, Uttar Pradesh, India

BD Sharma
Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh, India

SK Mendiratta
Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh, India

Vikas Pathak
College of Veterinary Sciences and AH, DUVASU, Mathura, Uttar Pradesh, India

Corresponding Author:
Meena Goswami
College of Veterinary Sciences and AH, DUVASU, Mathura, Uttar Pradesh, India

Quality evaluation of low sugar functional carabeef cookies incorporated with raftilose

Meena Goswami, BD Sharma, SK Mendiratta and Vikas Pathak

Abstract
The present study was conducted to develop and to evaluate quality characteristics of low sugar functional carabeef cookies. Formulation and processing technology of functional carabeef cookies was standardized by incorporating 50% carabeef powder as high protein source, 10%orange pulp powder as natural fiber, 1.5% guar gum to replace 40%added vegetable fat and baked at 150-160°C for 35-40 minutes. Functional carabeef cookies were incorporated with. 15, 20, 25% of raftilose as sugar replacer to develop low sugar carabeef cookies and compared with control for various physico-chemical properties and sensory evaluation. pH and moisture content increased however protein content decreased significantly (P<0.05) with incorporation of raftilose. There was no significant difference fat and ash content as well as in mean thickness, diameter and spread ratio values between control and raftilose incorporated low sugar functional carabeef cookies. Again, no significant difference was observed for instrumental textural and color values between control and treatments. Sensory scores including overall acceptability of raftilose incorporated carebeef cookies were significantly (P<0.05) lower than control, but there was no significant difference between RT1 and RT2. Therefore, RT2-- functional low sugar carabeef cookies prepared by incorporation of 20% raftilose were selected as the best treatment.

Keywords: Carabef cookies, carabeef powder, functional ingredients, raftilose, quality evaluation

Introduction
Livestock sector is an important component of India's economy in terms of income, employment and foreign exchange earnings. Driven by the structural changes in agriculture and food consumption patterns, the importance of buffalo meat sector has been undergoing a steady transformation. India accounts for about 43% of the world buffalo meat production, with Uttar Pradesh producing the most, followed by Andhra Pradesh and Maharashtra [1]. In recent years the buffalo meat industry for export has attracted heavy investment as we see major buffalo meat exporters expanding their processing capacities to meet demand in new worldwide markets. Production of beef and buffalo meat of India increased from 176 tonnes in 1970 to 4,287 tonnes in 2019 growing at an average annual rate of 9.91%. In 2019, production of beef and buffalo meat for India was 4,287 tonnes [1]. Buffalo meat (carabeef) contains high biological value protein and important micronutrients that are needed for good health throughout life. The protein content of the meat is highly related to the water holding capacity, emulsifying capacity and better nutritional quality of the meat. Buffalo meat is considered as healthy meat and is comparatively cheap than other red meat, hence can be utilized as cheap protein source to fight against hunger and malnutrition. Keeping these views in mind, minced carabeef powder was incorporated at optimum level in traditional refined wheat flour cookies. Cookies and biscuits are the most popular baked snacks which are much relished by consumers of every segment in India [2]. Cookies are known to generally contain fat (18.5%), carbohydrate (78.23%), ash (1.0%), protein (7.1%) and salt (0.85%) [3]. These carbohydrate fat and sugar rich energy dense cookies may not be liked by present day health conscious consumer. Hence, in previous study, cookies were made functional by incorporation of certain functional ingredients i.e. orange pulp fiber as fiber, guar gum as fat replacer etc. [4, 5, 6] to make these cookies healthy for consumers suffering from various life style diseases like obesity, hypertension and constipation. In similar way, sugar is also added in ample amount in baked snacks like cookies. Sugar along with fat is a vitally important ingredient in achieving the texture, mouth feel and bite of the biscuit. It is shown to have multiple functionalities by interacting with the different dough components during the various steps of dough mixing [7]. It has a major impact on texture of cookies as well as phase transitions of biopolymers such as

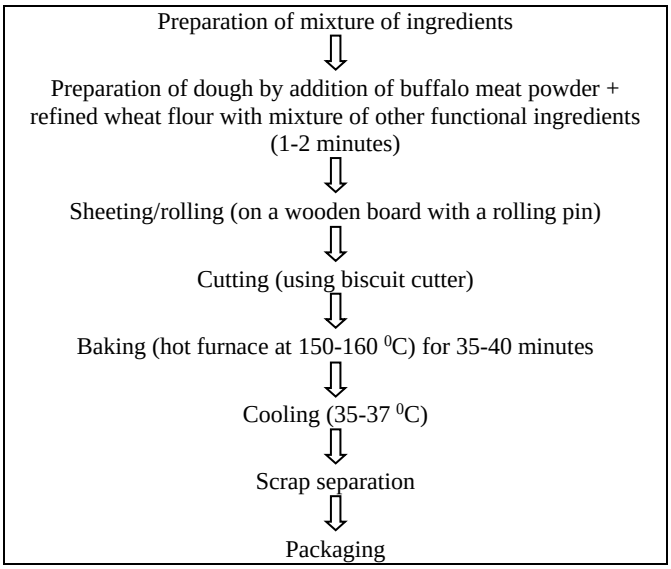
starch and gluten [8]. However Sugar has a bittersweet reputation and more consumption of sugar on regular basis may have ill effects on health like obesity, diabetes, cardiovascular disorders and some cancers [9]. This has led food researchers to develop low sugar food products with high nutritional value without compromising its taste and flavor. However, the reformulation of confectionery and bakery products with a substantial reduction in sugars has proven difficult due to the multiple functionalities that sugars exert in bakery products, next to simply providing sweetness [10]. Raftilose is a prebiotic oligosaccharide added in many bakery products as sugar replacer with taste of sweetness without added calories. Raftilose is commercially available powder containing chicory inulin (>99.5%, wt/wt), and a little glucose, fructose, and sucrose. It is considered to have little adverse effects on physic-chemical and sensory properties of bakery snacks. Therefore, present study was planned to develop and to evaluate quality characteristics of low sugar functional carabeef cookies with incorporation of Raftilose as sugar replacer.

Materials and Methods

The experiments were conducted in Division of Livestock Products Technology, Indian Veterinary Research institute, Izatnagar, Bareilly, India. Carabeef powder was prepared using boneless fresh meat of 4-5 years buffalo following method prescribed by Goswami *et al*. (2015). [4]. Other ingredients like refined wheat flour, skimmed milk powder, baking powder, sugar, salt and vanaspati ghee (hydrogenated vegetable fat) were purchased from local market of Bareilly. All the chemicals used in the study were of analytical grade and procured standard firms (Qualigen®, Hi-Media®, SDfine® etc.). Low density Polyethylene (LDPE) bags of 60µ thickness and PET jars were sourced from local market and sterilized by exposing to U.V. light for 30 minutes before use. They were used for packaging of carabeef cookies and carabeef powder respectively.

Preparation of carabeef cookies

Functional cookies were prepared by following method prescribed by Manohar and Haridas (1999) [11] with slight modifications [5]. Several preliminary trials were conducted to standardize carabeef powder, orange pulp powder and guar gum powder level in cookies for protein enrichment, fiber fortification and fat reduction respectively [5, 6, 12]. Formulation of functional carabeef cookies has been given in table 1. Protein enriched, fiber fortified and low fat functional cookies were further incorporated with three different levels i.e. 15, 20 and 25% of raftilose separately during dough preparation and were abbreviated as: C-functional carabeef cookies with no raftilose, RT1- functional carabeef cookies with 15% raftilose, RT2- functional carabeef cookies with 20% raftilose and RT3- functional carabeef cookies with 25% raftilose. The method of preparation of functional carabeef cookies is given in flow diagram1.



Flow diagram 1: Development of carabeef cookies

Table 1: Formulation of functional carabeef cookies

%	C	RT1	RT2	RT3
Refined wheat flour	50	40	40	40
Meat powder	50	50	50	50
Orange pulp fiber	10	10	10	10
Hydrogenated vegetable oil	35	21	21	21
Guar gum	0.525	0.525	0.525	0.525
Water to maintain fat %	13.475	13.475	13.475	13.475
Milk powder	20	20	20	20
Sugar	30	27	24	21
Raftilose	-	3	6	9
Glucose	5	5	5	5
Egg albumin	5	5	5	5
Vanilla essence	1.5	1.5	1.5	1.5
Baking powder	1.5	1.5	1.5	1.5
Salt	2	2	2	2

Analysis of product: Developed cookies were evaluated for various physico-chemical properties following standard procedures. The pH of carabeef cookies was determined as per Trout *et al*. (1992) method [13]. Cooking/baking yield was determined by dividing baked product weight by the raw unbaked weight and multiplying it by 100 to express as percent. Physical parameters viz., thickness, diameter and spread ratio of baked cookies were measured by methods described by Ajia *et al*. (2008) [14]. Proximate composition like ash, protein, fat, fiber and ash percentage were evaluated as per AOAC (1995) [15]. Textural profile analysis *i.e.* hardness and adhesiveness were evaluated measured by instrumental texture profile analyser (TA HD Plus Texture Analyser) as per Bourne (1978) [16] whereas shear force value was determined as per Berry and Stiffler (1996) [17]. Color values were estimated by Lovibond® tintometer (Model F, Greenwich, UK) to determine redness, yellowness, chroma and hue values using the formulae, $\tan^{-1}(b/a)$ (Little, 1975) and $(a^2+b^2)^{1/2}$ [18], respectively where a = red unit, b = yellow unit. Sensory evaluation was carried out by using eight-point hedonic scale with 8 point as extremely desirable and 1 as extremely poor [19] by semi trained sensory panelists from division of LPT, Indian Veterinary Research Institute, Izatnagar, Bareilly, India, A total of three replications were carried out with each analysis done in duplicate (n =6), except sensory studies where seven sensory panellists did sensory evaluation three times and n=21 observations were recorded for each sensory attribute.

Statistical analysis: The data generated from various trials under each experiment were pooled and analyzed by statistical method of one way-ANOVA and Mean±S.E using SPSS Statistics 20.0 software package developed as per the procedure of [20] and means were compared by using Dunkan's multiple range test [21].

Results and discussions

Standardization of functional ingredients to develop functional carabeef cookies

Several preliminary trials were carried out to standardize the formulation and processing technology of functional carabeef cookies. Carabeef cookies with incorporation of 50% carabeef powder, 10% orange pulp fiber as natural fiber and 1.5% guar gum powder to replace 40% of vegetable fat were developed as functional carabeef cookies and baking at 150-160 ^{0}C for 35-40 minutes was the most acceptable.

Optimization of level of raftilose in functional carabeef cookies as sugar replacer

Physico-chemical properties

The physico-chemical properties of raftilose incorporated functional carabeef cookies are presented in Table.2. ANOVA revealed no significant difference between control and treatments in physico-chemical properties except pH, moisture and protein percent. Mean pH values increased significantly (P<0.05) at higher level of raftilose incorporation, whereas no significant difference was observed between C and RT1. There was no significant difference in cooking yield between control and treatments. Moisture percent increased significantly (P<0.05) in RT2 and RT3 than control, but no significant difference was observed between RT2 and RT3. Hasmadi *et al*. (2014) also evaluated physico-chemical properties of commercially available semi-sweet low sugar biscuits and reported that moisture content of commercial low sugar biscuits ranged between 2.24%-3.23% [22]. In present study, protein content decreased significantly (P<0.05) with higher level of raftilose (25%) due to carbohydrate nature of raftilose. No significant difference was observed in protein percent between C, RT1 and RT2. There was no significant difference in fat and ash percent between control and treatments. Sofyan *et al*. (2013) also observed no significant difference for proximate parameters in low sugar gluten free cookies incorporated with different levels of inulin as sugar replacer [23]. There was no significant difference for mean thickness, diameter and spread ratio values between control and raftilose incorporated low sugar functional carabeef cookies, whereas Pareyt *et al*. (2011) observed that thickness of cookies decreased with incorporation of Arabinoxylan oligosaccharides as sugar replacer while cookies diameter had no significant change as compared to control [24].

Table 2: Physico-chemical properties of functional carabeef cookies incorporated with different levels of raftilose (Mean±SE)

Parameters	C	RT1	RT2	RT3	Treatment Mean
pH	5.67±0.01^c	5.70±0.02^c	5.79±0.01^b	5.95±0.01^a	5.78±0.02
Cooking yield (%)	82.15±0.05	82.21±0.11	82.27±0.12	82.15±0.14	82.19±0.05
Moisture (%)	2.87±0.04^b	2.97±0.03^{ab}	3.02±0.06^a	3.06±0.05^a	2.98±0.02
Protein (%)	43.01±0.30^a	42.50±0.40^a	42.47±0.41^a	42.19±0.26^b	42.54±0.14
Fat (%)	12.02±0.02	12.00±0.04	11.94±0.06	11.95±0.05	11.97±0.02
Ash (%)	2.94±0.01	3.00±0.04	2.99±0.07	3.07±0.03	3.00±0.02
Thickness (mm)	1.09±0.01	1.08±0.01	1.09±0.01	1.08±0.01	1.09±0.01
Diameter (mm)	54.90±0.03	54.98±0.08	55.10±0.21	55.08±0.16	55.01±0.06
Spread ratio	49.31±0.27	50.61±0.48	50.48±0.44	50.71±0.52	50.28±0.23

- Mean±SE with different superscripts in a row differ significantly (P<0.05)
- n= 6 for each treatment

Instrumental textural and color parameters

The textural and color parameters of functional carabeef cookies prepared by incorporation of raftilose are presented in Table.3. There was no significant difference between control and treatments for mean hardness, shear force and adhesiveness values. Handa *et al* (2012) also observed no significant change in peak breaking strength and hardness in low sugar cookies at lower level of oligosacchride incorporation; however replacement of sugar with fructo-oligosacchraides at 25-30% level showed softening effect of dough [25]. This contradiction with present study might be due to different baking temperature- time combination used for baking of cookies. In present study, functional cookies were baked for longer time due to addition of carabeef powder, which might have resulted into higher baking loss and hardening of carabeef cookies. There was no significant difference in redness, yellowness, chroma and hue angle values between control and low sugar functional carabeef

cookies. Gallagher *et al*. (2003) also observed no significant difference for color values in low sugar biscuits upto 25% sugar replacement with raftilose, however biscuits were darker in color [26]. They also observed that sugar replacement in biscuits at higher level (>30%) with raftilose had significantly (p<0.05) lower $L^*$and higher a^*values. Low sugar muffins prepared with incorporation of stevianna as sugar replacer had significantly (P<0.05) higher a^* values than control due to addition of cocoa powder which was added to product to hide off flavor of muffins caused by stevianna [27].

Table 3: Instrumental textural and color parameters of functional carabeef cookies incorporated with different levels of raftilose (Mean±SE)

Parameters	C	RT1	RT2	RT3	Treatment Mean
Hardness (N/cm^2)	5.86±0.06	5.85±0.10	5.91±0.12	5.99±0.12	5.90±0.05
Shear force value(kg/cm^2)	4.81±0.06	4.91±0.07	5.00±0.15	5.10±0.25	4.95±0.07
Adhesiveness (N/gm)	3.39±0.06	3.46±0.04	3.47±0.03	3.49±0.03	3.45±0.02
Redness	4.35±0.13	4.36±0.11	4.38±0.10	4.41±0.14	4.37±0.05
Yellowness	3.70±0.08	3.68±0.10	3.66±0.09	3.61±0.10	3.61±0.10
Chroma	5.71±0.13	5.71±0.11	5.72±0.08	5.71±0.16	5.71±0.05
Hue angle	0.87±0.04	0.89±0.05	0.90±0.06	0.93±0.04	0.90±0.02

- n= 6 for each treatment

Sensory evaluation

The sensory scores of raftilose incorporated low sugar carabeef cookies are presented in Table.4 ANOVA revealed significant difference (P<0.05) in the sensory scores treatments and control. Mean color and appearance scores decreased significantly (P<0.05) with increased level of raftilose, which might be due to more Maillard reaction between sugar and protein at higher level of raftilose incorporation. Handa *et al*. (2012) also observed dark color curst formation over raftilose incorporated functional biscuits providing them lower color scores [25]. Gennaro *et al*. (2000) reported that raftilose-P incorporation in baked snacks showed dark colored product than control due to more Maillard reaction and reducing capacity [28]. Mean flavor, texture, crispiness and aftertaste scores showed a decreasing trend in raftilose incorporated cookies as compared to control. It might be due to dark colored hard crust formation over cookies' surface due to Maillard reaction at higher level of raftilose incorporation. Scores of RT1 and RT2 for all these attributes were comparable. Overall acceptability scores decreased significantly (P<0.05) in treatments than control due to harder texture and lower flavor as well as color scores among treatments. As per Sahin *et al*. (2019) incorporation of sour dough containing *Leuconostoc citreum* TR116 at 10% level in low sugar biscuits did not have any adverse effect on sensory properties [29]. In present study, RT3 had significantly (P<0.05) lower scores than RT1 and RT2, however there was no significant difference between RT1 and RT2. Therefore, RT2-- functional low sugar carabeef cookies prepared by incorporation of raftilose to replace 20% of sugar level in control cookies.

Table 4: Sensory evaluation of functional carabeef cookies incorporated with different levels of raftilose (Mean±SE)

Parameters	C	RT1	RT2	RT3	Treatment Mean
Color and appearance	7.24±0.05^a	7.04±0.06^{ab}	6.85±0.06^{bc}	6.70±0.05^c	6.96±0.03
Flavor	7.16±0.05^a	7.07±0.06^{ab}	6.93±0.05^{bc}	6.72±0.04^c	6.97±0.03
Texture	6.94±0.12^a	6.71±0.09^{ab}	6.64±0.09^b	6.41±0.07^b	6.68±0.05
Crispiness	7.13±0.08^a	6.94±0.07^{ab}	6.79±0.05^{bc}	6.66±0.04^c	6.88±0.03
Aftertaste	7.12±0.05^a	6.97±0.04^{ab}	6.83±0.05^{bc}	6.67±0.05^c	6.90±0.03
Overall acceptability	7.09±0.05^a	6.71±0.03^b	6.57±0.04^b	6.40±0.05^c	6.69±0.03

- Mean±SE with different superscripts in a row differ significantly (P<0.05)
- n= 21 for each treatment

Conclusion

In present study, an attempt was made to improve functionality of functional carabeef cookies with incorporation of raftilose as sugar replacer. Incorporation of raftilose had no significant effect on textural and color parameters. The sugar replacement with raftilose resulted into harder and dark colored cookies at higher level, which also adversely affected sensory scores of carabeef cookies in terms of flavor and after taste scores at higher level of raftilose incorporation. Carabeef cookies with 20% raftilose level (RT2) obtained highest sensory scores among treatments. Therefore it can be concluded that low sugar functional carabeef cookies cab be prepared by incorporation of 20% raftilose as sugar replacer.

References

1. DAHD. http://dahd.nic.in/sites/default/filess/BAH_%26_FS_Book.pdf. 2019.
2. Economictimes.indiatimes.com/industry/consproducts/fmcg/cookie-demand-grows-while-biscuit-sales-slow/articleshow/70851123.cms. 2019.
3. Ayo JA, Ikuomola DS, Esan YO, Onuola OG, Ayo VA, Ekele V. Effect of added defatted beniseed on the quality of acha based biscuits. Journal of Food Science and Technology. 2010; 4:7-13.
4. Goswami M, Sharma BD, Mendiratta SK, Pathak V, Kumar RR, Talukder S *et al*. Standardization of formulation and processing conditions for development of nutritional carabeef cookies. Nutrition and Food Science. 2015: 45(5):677-687.
5. Goswami M, Sharma BD, Mendiratta SK, Pathak V. Development and quality assessment of fiber enriched functional carabeef cookies. Veterinary Practitioner. 2017; 18:136-140.
6. Goswami M, Sharma BD, Mendiratta SK, Pathak V, Sharma H. Efficiency of dried plum powder as fat replacer in buffalo meat incorporated cookies. Fleischwirtschaft International. 2019; 3-2019:53-57.
7. Sman RGM, Renzetti S. Understanding functionality of

sucrose in biscuits for reformulation purposes. Critical Reviews in Food Science and Nutrition. 2018; 59(14):2225-2239.
8. Kawai K, Hando K, Thuwapanichayanan R, Hagura Y. Effect of stepwise baking on the structure, browning, texture, and in vitro starch digestibility of cookie. LWT-Food Science and Technology. 2016; 66:384-89.
9. Rippe JM, Theorode JM. Relationship between Added Sugars Consumption and Chronic Disease Risk Factors: Current Understanding. Nutrients. 2016; 8(11):697.
10. Mariotti M, Lucisano M. Sugar and sweeteners. In Bakery products science and technology. 2nd ed.2014, 199–221.
11. Manohar SR, Haridas OR. Effect of emulsifiers, fat level and type on the rheological characteristics of biscuit dough and quality of biscuits. Journal of Science Food and Agriculture. 1999; 79:1223-1231.
12. Goswami M, Sharma BD, Mendiratta SK, Pathak V. Quality evaluation of functional carabeef cookies incorporated with guar gum (*Cyamopsis tetragonoloba*) as fat replacer. Nutrition and Food Science. 2018; 49(3):432-440.
13. Trout ES, Hunt MC, Johnson DE, Claus JR, Kastner CL, Kropt DH. Characteristics of low fat ground beef containing texture modifying ingredients. Journal of Food Science. 1992; 57(1):19-24.
14. Ajila CM, Leelavathi K, Rao UJSP. Improvement of dietary fiber content and antioxidant properties in soft dough biscuits with the incorporation of mango peel powder. Journal of Cereal Science. 2008; 48**:**319-326.
15. AOAC. Official Method of Analysis. 16th Edn. Association of Official Analytical Chemists, Washington, DC, 1995.
16. Bourne MC. Texture Profile analysis. Journal of Food Science. 1978; 32:62-67.
17. Berry BW, Stiffler DM. Effect of electrical stimulation, boiling temperature, formulation and rate of freezing on sensory, cooking, chemical and physical properties of ground beef patties. Journal of Food Science. 1996; 46:1103-1106.
18. Froehlich DA, Gullet EA, Usborne WR. Effect of nitrite and salt on the colour, flavor and overall acceptability of ham. Journal of Food Science. 1983; 48:152-154.
19. Keeton JT. Effect of fat and sodium chloride/phosphate levels on the chemical and sensory properties of pork patties. Journal of Food Science. 1983, 878-81.
20. Snedecor GW, Cochram WG. Statistical Methods, 8th ed. The Iowa State University Press, Ames, Iowa, USA. 1995, 593.
21. Dunkan DB. Multiple range and multiple F test. Biometrics. 1995; 1:1-8.
22. Hasmadi M, Siti Faridah A, Salwa I, Matanjun P, Abdul Hamid M, Rameli AS. The effect of seaweed composite flour on the textural properties of dough and bread. Journal of Applied Phycology. 2014; 26:1057-1062.
23. Sofyan M, Selma AH, Radwan A, Badyan O, Yousef T. Enhancing the nutritional value of gluten free cookies with inulin. Advanced Journal of Food Science and Technology. 2013; 5(7):866-870.
24. Pareyt B, Goovaerts M, Broekaert WF, Delcour JA. Arabinoxylan oligosaccharides (AXOS) as a potential sucrose replacer in sugar-snap cookies. LWT-Food Science and Technology. 2011; 44:725-728.
25. Handa C, Goomer S, Siddhu A. Physico-chemical properties and sensory evaluation of fructoligosaccharide enriched cookies. Journal of Food Science and Technology. 2012; 49(2):192-199.
26. Gallagher E, O'Brien CM, Scannell AGM, Arendt EK. Evaluation of sugar replacers in short dough biscuit production. Journal of Food Engineering. 2003; 56**:**261-263.
27. Gao J, Brennan MA, Mason SL, Brennan CS. Effects of Sugar Substitution with (Stevianna) on the Sensory Characteristics of Muffins. Journal of Food Quality. 2017. https://doi.org/10.1155/2017/8636043
28. Gennaro SD, Birch GG, Parke SA, Stancher B. Studies on the physicochemical properties of inulin and inulin oligomers. Food Chemistry. 2000; 68:179-183.
29. Sahin AW, Rice T, Zannini E, Kieran KM, Coffey A, Arendt EK. The incorporation of sourdough in sugar-reduced biscuits: a promising strategy to improve techno-functional and sensory properties. European Food Research and Technology. 2019; 245:1841-1854