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Evaluation of grape pomace and quality of enriched cookies after standardizing baking conditions

AJAY KUMAR SHARMA*, RAJKUMAR A DAGADKHAIR[1] AND RG SOMKUWAR

ICAR-National Research Centre for Grapes (Pune) India

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ABSTRACT

Considering health benefits, consumers are demanding special foods worldwide. Among the ready to eat grain based baked foods, cookies are well preferred by consumers. By-products of wineries like pomace, lees etc. have antioxidant activities beside nutritional and rheological properties, Addition of pomace in different bakery foods enhanced nutritional and functional properties as well as improved sensory parameters. In present study, baking conditions were standardized along with optimizing quantity of pomace powder for making acceptable cookies. Different sources of pomace powder were evaluated for functional and nutritional properties. Among the various sources, significant differences were recorded in content of phenols, tannins, anthocyanins, protein and carbohydrates. Pomace of Manjri Medika contained phenols, tannins, anthocyanins, protein, carbohydrates and colour intensity. Antioxidant activities were varied from 269.22 to 296.33 per cent with non-significant difference, when measured by DPPH assay. On the basis of obtained results, 15% WGPP was added to prepare cookies. Darkest colour was observed in cookies prepared from Manjri Medika. But cookies made by addition of pomace from Sauvignon Blanc were recorded with higher values of various sensory parameters namely texture, mouth sensation, aroma, taste and overall acceptability. On the basis of results of present study, 15% WGPP is found acceptable to prepare cookies. The sources of pomace affect different properties and variations were reflected in prepared cookies also. More attractive cookies were prepared by WGPP of Manjri Medika but cookies from added pomace of Sauvignon Blanc were found better based on organoleptic study.

Keywords: Baking, anthocyanins, crude fiber, functional properties, sensory

INTRODUCTION

Wine industry develops many by-products, even after going through fermentation of grapes. These products have huge amount of phenolic compounds, depending on the type of grape, the part of the tissue as well as processing conditions. A fair amount of flavanols, flavonoids, anthocyanins and phenolic acids are noted (Lafka *et al.*, 2007) in the by-products generated during wine making process. It is noted that the grape pomace and stem are valuable sources of soluble dietary fiber (SDF) and Klasonlignin (Llobera and Canellas, 2007). The skin of wine grape pomace is ideal source of dietary fiber having good content of bioactive compounds (Deng *et al.*, 2011). Red wine grape pomace contains higher total phenolic content in comparison to white wine grape pomace powder. It is well evident that the phenolics have potential beneficial impact on human health as these phenolics have antioxidant, antimicrobial, antiviral, and anti-inflammatory properties.

Dietary fiber is another predominate functional component in wine grape pomace, and has benefits of reducing the risk of cardiovascular diseases, cancer, and diabetes (Lizarraga *et al.*, 2011).However, not much work has been done worldwide on utilization of winery by-products; while some countries are using/recycling about 30–40 % of winery waste. Huge quantity of grape waste is generated by Indian wine industry, but there is no utilization on large scale except preparing grape seed oil by one winery. Disposal of pomace is major environmental problem also. Presently, waste material is disposed by burning in open fields, which results in loss of potential source of organic matter and valuable plant nutrients and functional materials (Sharma *et al.*, 2017). The research activities based on the use of grape pomace in making baked products like cookies, biscuits have already been initiated and very encouraging results have been obtained in different countries.

As per an estimate, at present in Indian market health category in the biscuit sector that includes digestive biscuits is pegged at around Rs. 400 crore and growing by 15-16% every year (Anonymous, 2016). The industry is mainly governed by increased disposable income, changed lifestyles, improved organized retailing and increased demand of processed and packaged food materials. Also, concerns like growing media coverage of health, rising incidence of health conditions, increasing concerns over physical appearance, changing lifestyles, and soaring costs of healthcare have led the biscuits and cookies market to move further on a healthier path. To fulfill the demand and maintain supply of the demanded food material as per consumers choice is most important task of the industry.

Maner *et al.* (2017) clearly indicated that the addition of winery by-product i.e. wine grape pomace powder (WGPP)

[1]ICAR-Directorate of Cashew Research (Puttur) India
*Corresponding Author Email:Ajay.Sharma1@icar.gov.in

positively improved various properties of cookies. Nutritional, functional and sensory properties of cookies were increased when pomace powder of Cabernet Sauvignon was used in recipe of cookies. However, the availability of various constituents of pomace is affected by many factors like variety, harvesting at particular stage, maceration duration, yeast strains or culture used for winemaking, winemaking conditions, pressure used for separation of wines from pomace, pomace drying temperature etc. Same time standardization of recipe with suitable baking temperature has also its own importance and directly affect sensory properties of prepared cookies. Considering the importance of pomace powder and availability in plenty, present studies were conducted to standardize recipe and baking temperature, evaluation of different types of pomace powders and comparison of cookies based on nutritional, functional and sensorial properties.

MATERIAL AND METHODS

Present study was conducted to maximize addition of wine grape pomace powder (WGPP) with comfort acceptance during sensory evaluation as well as evaluation of different pomace sources. Impacts of different types of pomaces were evaluated in cookies when standardized quantity of WGPP was added. These studies were conducted at ICAR-NRC for Grapes, Pune.

Standardization of WGPP quantity and baking conditions

To standardize quantity of WGPP to replace fine wheat flour, five combinations were tried including control where WGPP was not added. Details of combinations of different ingredients are presented in Table 1. Raw materials for cookies making were of standard quality. Wine grape pomace powder was prepared following the method described by Maner *et al.* (2017). Mixing and kneading were done to form dough. After dough formation, it was kept for 30–40 min. Round shape was given to cookies using cutter and transferred into trays for baking. A set of cookies was baked at the temperature adopted traditionally (160-180 °C) for 15 minutes.

Table1: Recipe for a kg product made from wine grape (Cabernet Sauvignon) pomace powder

Raw material	T1 (Control)	T2 (15% WGPP)	T3 (20% WGPP)	T4 (25% WGPP)	T5 (30% WGPP)
Maida (g)	1000	850	800	750	700
Wine grape pomace powder (WGPP) (g)	0	150	200	250	300
Sugar (g)	400	400	400	400	400
Margarine (g)	500	500	500	500	500
Butter (g)	100	100	100	100	100
Milk (g)	20	20	20	20	20
Baking powder (g)	10	10	10	10	10

While another set of cookies was prepared under modified conditions as described in Table 2, to standardize baking temperature, time and concentration of WGPP to replace fine wheat flour powder. After cooling cookies were packed in airtight plastic bags and stored at lower temperature (4°c) for further physico-chemical and sensory analysis. After standardization of baking conditions, acceptable level (15%) of WGPP from different sources were added and baked at 140 °C for 15 minutes. Prepared cookies were evaluated for nutritional, functional and sensory properties.

Properties of pomaces from different sources and prepared cookies

The pomaces obtained from different 13 sources including red wine grapes (Cabernet Sauvignon, Cabernet Franc, Petit Verdot, Merlot, Syrah, Caladoc, Cinsaut, Tempranillo, Nielluccio and Grenache) white wine grapes (Sauvignon Blanc and Grewurztraminer) and juice variety (ManjriMedika) were collected and processed as per standard methodology followed by Maner *et al.* (2017). Processed samples were evaluated for their nutritional and functional properties. On the basis of results obtained from addition of different levels of pomace and impact on sensory quality, 15 percent wheat flour was replaced by pomace powders of mentioned sources and cookies were baked at 140 °C for 15 minutes. Prepared cookies were packed and stored at low temperature up to recording the data on physio-chemicals and sensory properties.

The pomace powders from different sources and prepared cookies were evaluated for their functional as well as nutritional properties. Total phenolic content (TPC) was estimated with Folin-Ciocalteu reagent by using gallic acid as standard phenolic compound (Slinkard and Singleton, 1977). Anthocyanin content was estimated by adopting standard method (Picinelli *et al.*, 1994) and for colour intensity; method of Somers and Evans was followed (Sommers and Evans, 1977).

Tannin contents in cookies were measured by Folin Denis method (Singleton and Rossi 1965). The antioxidant activities were measured by DPPH assay (Brand-Willams *et al.*, 1995) and for estimation of protein, Lorry method was followed (Lowry *et al.*, 1951). Carbohydrate content was estimated as per method of Hedge and Hofreiter (1962). Crude fiber in cookies was quantified by following standard method of AOAC (AOAC, 2000).

A sensory panel of 20 members comprising 10 male and 10 female was trained for sensory studies of cookies. The sensory attributes viz.; colour, appearance, aroma, texture, taste, mouth sensation and overall acceptability were considered for evaluation of cookies. The products were sensory evaluated based on 5 point Hedonic scale. The assessment procedures of scoring was based on quality attributes of cookies. The data were collected from three replications of each treatment. The obtained data on different parameters were statistically analyzed by using completely randomized design (CRD).

RESULTS AND DISCUSSION

Baking conditions

Baking time and temperature affect the quality of cookies. It affects heat transfer and the quality of a baked product. Due to complex physico-chemical interactions that occur between the ingredients, it leads to the difference, primarily in texture, aroma and color of the products (Shibukawa *et al.*, 1989). It has interaction with raw material used in preparing dough. Baking is not only performed to elevate the product temperature but also to induce some biochemical reactions of ingredients.

Table 2: Baking performance of fortified cookies

Treatments (Pomace conc. in %)	Traditional baking			Modified baking		
	Temperature (°C)	Time (min)	Baking performance	Temperature (°C)	Time (min)	Baking performance
T1 (Control)	160-180	15	Acceptable	-----	-----	------
T2 (15)	160-180	15	Little Burnt flavor but acceptable	155	17	Acceptable with better crisp
T3 (20)	160-180	15	Burnt flavor, not acceptable	145	17	Acceptable with crisp
T4 (25)	160-180	15	Burnt flavor, not acceptable	140	17	Acceptable but little hard
T5 (30)	160-180	15	Burnt flavor, not acceptable	135	17	Acceptable but very hard

Data presented in Table 2 showed that by increasing the content of WGPP, the taste of cookies changed from acceptable in control to burnt flavor and not acceptable in T3 and onward. In second set, different levels of temperature maintained during baking of 17 minutes. Acceptance level of cookies was widen up to 30 per cent of WGPP, but texture of cookies hard. The WGPP @ 15% was found better. By increasing WGPP content in cookies, crude fiber, TPC and antioxidant activities of cookies were increased and maximum values were noted in T5. Drastic enhancement was noted in content of total phenolic content as well as antioxidant activities of WGPP added cookies in comparison to control (Fig. 1). It was due to presence of phenolics and fibers in pomace. Total dietary fiber and TPC in cookies increased in proportion of increasing pomace level (Accun and Gul, 2014). Wine grape pomace is known for its functional properties and these active compounds and antioxidant activities were found in WGPP enriched cookies by Maner *et al.* (2017). Saric *et al.* (2014) also mentioned that baking conditions including temperature and time have high impact on properties of the cookies. On the basis of final product quality, Teshome *et al.* (2017) recorded that baking temperature and time were the most important factors in deciding biscuit quality. Biscuits baked at low temperature were found slighter thick and resulted in better overall acceptability. Kuchtová *et al.* (2016) recorded that cookies prepared with addition level of 15 % grape skin pomace observed with highest overall acceptability. They concluded, the grape skin pomace incorporated in cookies as a partial replacement up to 15 % of composite flour not negatively affect the sensory quality Addition of 15% WGPP was found suitable in present study also.

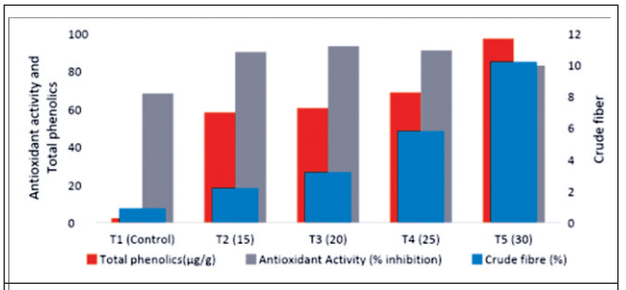

Fig. 1: Functional properties of Fortified cookies following modified baking

Pomace source and quality

Wine pomace was undervalued for a long time and treated as waste material generated by wineries during wine making process. While it is very rich in nutritional and functional properties beside improve the rheological and sensory properties of food materials when added. The data presented in Table 3 pertain to functional and nutritional levels of WGPP affected by their source. Among the various sources, significant differences were recorded in content of phenols, tannins, anthocyanins, protein and carbohydrates. Anthocyanins have direct relation with colour intensity. Hence, colour intensity also showed significant differences among the pomaces of different varieties. However, antioxidant activities showed non-significant differences. TPC content varied from 17.77 mg/g in Grenache to 44.01 mg/g in Manjri Medika. Tannin content was also maximum in Manjri Medika and minimum was in Grenache. Manjri Medika was recorded with maximum anthocyanins i.e. 78.39 mg/kg while it was minimum in Grewurztraminer followed by Sauvignon Blanc (white wine grape varieties). Antioxidant activities varied from 269.22 to 296.33 per cent with non-significant difference, when measured by DPPH assay.

Carbohydrate content in pomaces varied from 8.56 g/100g in Syrah to 24.51 g/100g in Sauvignon Blanc and differed significantly. Large variation was noted in range of protein content. It was varied from 5.50 g/100 g in Tempranillo to 19.52

g/100 g in Manjri Medika. In general, protein content of wine pomace may range between 6% and 15% (dry matter) depending on grape variety and harvesting conditions. But in pomace of Manjri Medika, protein content was much higher. Colour content of pomace has its own importance as it imparts attractive colour to cookies. Minimum colour intensity (8.05) was recorded in pomace of Sauvignon Blanc followed by Grewurztraminer, as these are white wine grape varieties and have no anthocyanins in skin. Maximum colour intensity (40.79) was noted in Manjri Medika followed by Syrah and Tempranillo. These are red varieties and Manjri Medika is well known for higher anthocyanins content in comparison to others. As per data of present study, the source of pomace affected functional as well as nutritional aspects of pomace. The composition of grapes may vary depending on extrinsic factors such as climatic conditions (Kliewer, 1977) and viticultural practices followed in vineyards (Freeman *et al*., 1979), as well as intrinsic factors such as variety and level of maturity at the time of harvesting (Gonzalez-SanJos *et al*., 1993 and Robredo *et al*., 1991).

The residues of grape contain proteins, lipids, carbohydrates, vitamins, minerals, and compounds with important biological properties such as phenolic compounds (tannins, phenolic acids, anthocyanins, and resveratrol), depending on the type of waste, the cultivar, climatic and cultivation conditions (Sousa *et al*., 2014; Karovičová, *et al*., 2015). Similarly, type of process and the conditions under which winemaking was carried out also have impact on composition of wine pomaces (Perez-Magari´no S and Gonzalez-SanJos´e2000).

Table 3: Nutritional and functional properties of Pomace powder of different varieties

Source Variety	Phenol mg/g	Tannins mg/g	Protein g/100g	Carbohydrate g/100g	Anthocyanins mg/kg	Antioxidant mg/g (DPPH assay)	Colour intensity %
Sauvignon Blanc	18.46	18.89	7.55	24.51	1.88	292.01	8.05
Grewurztraminer	20.43	20.83	7.06	14.88	1.34	284.01	9.75
Merlot	25.16	21.11	5.73	13.39	9.31	289.18	22.49
Caladoc	28.01	21.03	7.12	11.34	26.46	290.68	17.73
Cabernet Franc	28.57	27.92	7.04	13.29	9.25	296.33	28.95
Cabernet Sauvignon	26.21	23.68	7.23	12.70	19.70	290.26	31.54
Petit Verdot	20.52	22.85	6.38	11.69	31.11	269.22	29.04
Cinsaut	21.22	21.08	6.62	9.12	7.89	290.51	30.66
Tempranillo	19.36	19.23	5.50	12.03	14.34	291.68	32.48
Grenache	17.77	18.43	5.86	11.62	10.80	292.28	17.97
Niellucio	25.89	24.80	12.01	13.60	14.56	288.66	23.76
Syrah	28.45	25.71	14.27	8.56	28.41	295.21	32.93
ManjriMedika	44.01	39.61	19.52	16.39	78.39	294.26	40.79
C.D. at 5%	2.883	2.994	0.824	2.620	0.695	N/A	1.998

Pomace source and quality of enriched cookies

The data on functional properties of cookies by replacement of 15% fine wheat flour by different sources of pomaces are presented in Table 4. Anthocyanins in cookies were varied from 0.58 mg/kg in Sauvignon Blanc to 56.34 mg/kg in cookies enriched by addition of Manjri Medika pomace. It is clear from data presented in Table 3 that Manjri Medika contained maximum anthocyanins and same trend was observed in cookies also. Sauvignon Blanc variety used for white wine making, was registered with very low levels of anthocyanins, and same low level content of anthocyanins in cookies prepared by Sauvignon Blanc was found. TPC in cookies was recorded from 0.65 (Caldoc) to 1.39 mg/g (Cabernet Sauvignon).

Maximum content of tannins (1.35 mg/g) was estimated in cookies enriched by addition of pomace of Cabernet Sauvignon. The cookies prepared by addition of Petit Verdot pomace were found with minimum tannins content (0.63 mg/g). Beside significant differences in content of anthocyanins, TPC and tannins in cookies prepared by addition of WGPP of different sources, non-significant differences were noted in antioxidant activities and surprisingly cookies made from Sauvignon Blanc pomace recorded with higher antioxidant capacity followed by Manjri Medika.

Table 4: Functional properties of cookies affected by different sources of pomace powder

Source pomace	Anthocynins mg/kg	Phenols mg/g	Tannins mg/g	Antioxidant mg/g DPPH assay
Sauvignon Blanc	0.58	0.82	0.86	225.55
Grewurztraminer	0.69	0.70	0.76	221.25
Merlot	2.59	1.00	1.15	223.05
Caladoc	18.42	0.65	0.85	220.35
Cabernet Franc	3.48	0.82	0.94	219.65
Cabernet Sauvignon	10.21	1.39	1.35	224.15
Petit Verdot	22.21	0.71	0.63	222.65
Cinsaut	1.52	1.09	1.23	223.25
Tempranillo	12.72	0.69	0.68	219.65
Grenache	3.22	0.74	0.79	223.85
Niellucio	5.21	1.02	1.01	220.40
Syrah	14.43	0.79	0.98	221.65
Manjri Medika	56.34	0.99	0.99	225.20
CD at 5%	3.682	0.182	0.178	N/A

The data related to organoleptic study of prepared cookies are presented in Fig. 2 and Fig. 3. Darkest colour was observed in cookies prepared from ManjriMedika. But cookies prepared by addition of pomace from Sauvignon Blanc were noted with higher values of various sensory parameters namely texture, mouth sensation, aroma taste and overall acceptability. Minimum overall acceptability was score in Grenache followed by ManjriMedika. The darker colour of baked foods is expected to have the higher impact on the preferences of consumers. In present study, pomace of ManjriMedika was observed with maximum colour intensity and same was noted in cookies also. But cookies prepared by ManjriMedika were scored at very low level during organoleptic test. Overall acceptability is governed by different dominant sensory quality attributes (Ganorkar and Jain 2014), not only colour.

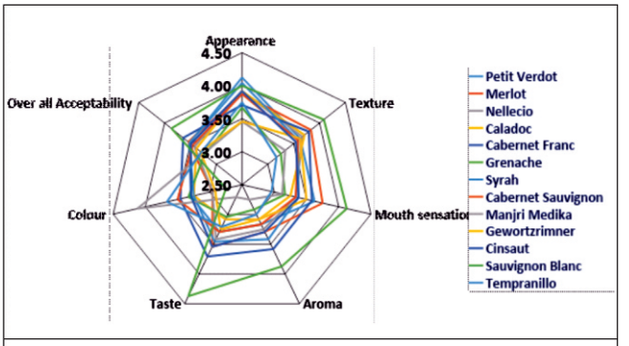

Fig. 2 : Sensory properties of enriched cookies

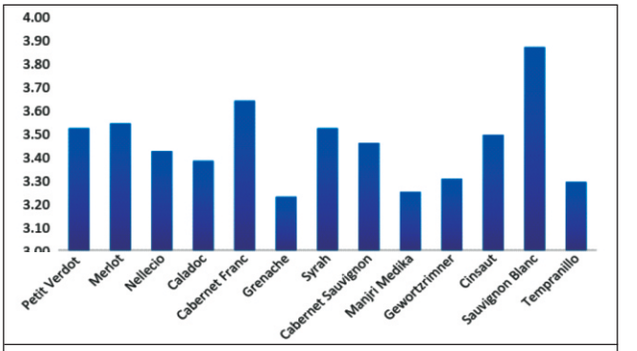

Fig. 3 : Overall acceptability of enriched cookies

CONCLUSION

On the basis of results of present study, addition of 15% WGPP is found better for preparation of acceptable cookies when baked at 155^{0}c temperature for 17 minutes. The sources of pomace affect different properties and variations were reflected in prepared cookies also. More attractive cookies were prepared by WGPP of Manjri Medika with better functional properties like TPC and anthocyanins but cookies made from addition of Sauvignon Blanc pomace were found better based on organoleptic study.

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