

INFLUENCE OF SPRAY-DRIED AVOCADO SEEDS AND RED PEPPER POWDERS ON THE ANTIOXIDANT ACTIVITY AND COLOUR PROPERTIES OF VEGAN BURGER PATTIES

İlayda İşleyen¹, Pınar Kadioğlu Şentürk¹, Hilal Sena Yıldırım¹ and Kezban Candoğan^{1*}

¹ Ankara University, Faculty of Engineering, Department of Food Engineering, Ankara, Turkey

*Corresponding author email: candogan@eng.ankara.edu.tr

I. INTRODUCTION

These days, meat alternatives are drawing more attention than in the recent past due to issues related to animal welfare, impact on the environment of traditional meat production practices and public health concerns about consumption of meat products [1]. The quality of meat alternatives is highly dependent on colour and colour variations. Therefore, colouring agents are an important part of the formulation of plant-origin products [2]. The demand for meat alternatives is promoting the development and use of natural colourants with health promoting effects. Avocado seeds have greater antioxidant activity and polyphenol content than the fruit itself [3]. Previous research has shown that mixing grinded avocado seeds with water results in a bright orange colour in the presence of oxygen. Red pepper as a good source of vitamins A, C and E is included in many national cuisines due to its sensory properties such as colour, pungency, taste and aroma. It also could be a good colour alternative for the formulation of meat analogues. This study was aimed 1) to manufacture plant-based meat analogues by using chickpea, green pea and lentil with the addition of different levels of spray-dried avocado seed powder (ASP) and powdered sweet red pepper (PRP) as colouring agents, 2) to investigate the effect of adding ASP and PRP on the pH, antioxidant activity and phenolic content, as well as colour alterations during cooking for various times.

II. MATERIALS AND METHODS

All the ingredients were purchased from a local market in Ankara. Chickpeas, green peas and lentils were cooked by boiling and then homogenized in a blender before use. All vegan burger formulations consisted of 10% breadcrumbs, 30% cooked chickpea, 20% cooked green pea, 20% cooked lentil, 10% distilled water, 7% olive oil, 1% salt, 1% garlic powder and 1% onion powder. Avocado seeds were spray-dried in a laboratory scale spray-drier whereas a commercial sweet powder red pepper was used. Seven groups of vegan burger formulations were prepared including 1) control (C), 2) 5% ASP added group (A5); 3) 10% ASP added group (A10), 4) 5% PRP added group (P5), 5) 10% PRP added group (P10), 6) 5% ASP+PRP (ratio, 1:1, w:w) added group (AP5), 7) 10% ASP+PRP (ratio, 1:1, w:w) added group (AP10). Individual patties of 25 g each were manually formed for each group and kept at 4°C. Cooking times were for 25, 35, 45, 55 and 65 min, all at 90°C. The pH; antioxidant activity (DPPH free radical scavenging activity, % inhibition); total phenolic content (mg gallic acid equivalent (GAE)/kg); CIE* lightness (L^*), redness (a^*) and yellowness (b^*) values, and colour change (ΔE) were evaluated for both raw and cooked samples. Data from two replications were evaluated by analysis of variance with Tukey's multiple comparison test ($P < 0.05$) using Minitab statistics software.

III. RESULTS AND DISCUSSION

The pH values of the vegan burgers ranged between 5.75-6.27 (Table 1). There was no significant effect of ASP and PRP addition on the pH values of vegan burgers ($P > 0.05$). As expected, addition of ASP and PRP resulted in higher antioxidant activity where the highest antioxidant activity was determined in A10 group ($P < 0.05$) followed by A5, AP10 and P10 groups. The highest total phenolic content was determined in AP10 vegan burger patties ($P < 0.05$).

Table 1 The pH, DPPH radical scavenging activity (% inhibition) and total phenolic content (mg gallic acid equivalent (GAE)/kg) of vegan burger patties formulated with different levels of ASP and PRP

Sample Groups	pH value		DPPH radical scavenging activity					Total phenolic content				
	BC	AC	SEM	P Value	BC	AC	SEM	P value	BC	AC	SEM	P value
C	6.17 ^{abA}	6.09 ^{aB}	0.02	0.04	4.50 ^{dB}	8.66 ^{dA}	1.20	<0.01	2.42 ^c	1.59 ^b	0.26	0.09
A5	6.18 ^{abA}	6.10 ^{aB}	0.02	0.01	17.6 ^e	12.6 ^{bc}	1.54	0.06	4.26 ^{bA}	2.35 ^{bB}	0.56	0.02
A10	6.27 ^{aA}	6.11 ^{aB}	0.04	0.02	24.3 ^{aB}	26.7 ^{aA}	0.67	<0.01	2.60 ^{cB}	4.90 ^{aA}	0.67	0.01
P5	6.08 ^{bc}	5.93 ^b	0.04	0.11	12.5 ^{cA}	10.1 ^{cdB}	0.71	0.01	2.32 ^{cB}	4.94 ^{aA}	0.75	<0.01
P10	5.81 ^d	5.75 ^d	0.02	0.18	16.0 ^b	16.1 ^b	0.32	0.92	2.58 ^{cB}	6.32 ^{aA}	1.11	0.03
AP5	5.94 ^{cd}	5.86 ^{bc}	0.02	0.07	12.4 ^{cA}	9.53 ^{cdB}	0.84	0.01	3.76 ^{bA}	1.44 ^{bB}	2.60	<0.01
AP10	5.87 ^d	5.83 ^{cd}	0.01	0.26	18.7 ^b	15.9 ^b	0.98	0.18	5.17 ^a	5.62 ^a	5.40	0.25
SEM	0.10	0.10			1.60	1.60			0.20	0.50		
P Value	<0.01	<0.01			<0.01	<0.01			<0.01	<0.01		

SEM: Standard error of the mean. BC: Before cooking; AC: After cooking. ^{a-e}: For each attribute means with different superscript letters in the same column are statistically significant (P<0.05). ^{A-B}: Within a group, for each attribute, means with different superscript letters in the same row are statistically significant (P<0.05).

Addition of ASP and PRP decreased L^* value and increased a^* and b^* values (P<0.05) resulting in darker, redder and yellower colours in the vegan burger products (Table 2). ASP addition appeared to be more efficient to enhance a^* value when it was added at 10% level (P<0.05). When taking together the ΔE values, which were calculated for each cooking time with reference to the colour change of the samples at time zero, in general, the ΔE values demonstrated a decrease after 45 min. This was likely due to the completion of the cooking process at the 45th min.

Table 2 CIE L^* , a^* and b^* values of vegan burger patties formulated with different levels of ASP and PRP

Sample Groups	L^*	a^*	b^*
C	60.2 ^A	1.49 ^C	27.4 ^B
A5	54.3 ^B	12.2 ^B	35.6 ^A
A10	47.9 ^C	17.1 ^A	34.6 ^A
P5	50.0 ^C	12.8 ^B	35.7 ^A
P10	50.6 ^{BC}	11.5 ^B	35.4 ^A
AP5	51.4 ^{BC}	9.89 ^B	32.7 ^{AB}
AP10	43.8 ^D	17.3 ^A	33.4 ^A
SEM	1.30	1.30	0.70
P Value	<0.01	<0.01	<0.01

SEM: Standard error of the mean. ^{A-D}: For each attribute, the difference between the means with different superscript letters in the same column is statistically significant (P<0.05).

IV. CONCLUSION

The result of this study demonstrated that spray-dried avocado seed powder and powdered red pepper enhanced colour of vegan burgers providing healthier alternatives with increased antioxidant activity. Therefore, this study can be a reference point for research to develop appealing as well as health promoting meat analogues.

REFERENCES

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