DIELECTRIC PROPERTIES OF
SOUR CHERRY (*Prunus cerasus* L.) POMACE:

INFLUENCE OF FREQUENCY CONCENTRATION pH TEMPERATURE AND PARTICLE SIZE

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Landfills reduce waste?

- **SC production**: 1.2 MT

- **Largest producer**:
  The Republic of Turkey
  (0.2 MT)

- **Leftover**: 0.4MT

Objectives of the study

To determine process parameters for fast and uniformly treated-samples

- Extraction of bioactive compounds from SCP by dielectric heating

- Formulation of the fortified baked products

- Valorization of waste and by-products

Juice industrial waste : **Sour cherry pomace(SCP)**

Independent Variables

Frequency (915, 2450 MHz)
Particle size (Ps) (50, 100, 140, 200, 230 mesh)
Temperature (T) (0, 20, 40, 60, 80°C)
- *Conventional*
- *Microwave*

Concentration (C)* (2.5, 5, 7.5, 10, 12.5%)
pH (2.0, 4.0, 6.0, 8.0, 10.0)
Sugar content (0.25, 0.5, 0.75, 1%)
- *Glucose*
- *Sucrose*

Salt content (0.25, 0.5, 0.75, 1%)
- *Sodium chloride*

*Medium distilled water

Dependent Variables

ε'

ε''

D_p

Temperature, concentration, particle size effects on ε''

Source	Conventional heated				MW heated			
	Sum of Squares	Coefficients	p-value		Sum of Squares	Coefficients	p-value	
Model*	59.29		< 0.0001	significant	63.37		< 0.0001	significant
A-Temperature	*8.33*	*+0.95*	*0.0004*		*26.35*	*+1.69*	*< 0.0001*	
B-Concentration	*37.82*	*+2.15*	*< 0.0001*		*28.76*	*+1.88*	*< 0.0001*	
C-Particle size	0.1419	+0.13	0.5096		0.7105	+0.29	0.0470	
AB	*1.89*	*+0.74*	*0.0316*		0.2374	+0.26	0.2198	
AC	0.5716	-0.37	0.2000		0.0485	-0.11	0.5673	
BC	1.19	+0.48	0.0757		0.0461	+0.09	0.5768	
A²	1.36	-0.60	0.0604		4.32	-1.07	0.0002	
B²	1.75	+0.82	0.0371		0.4201	+0.40	0.1123	
C²	0.2785	-0.31	0.3607		0.2381	-0.29	0.2192	
Residual	3.04				1.39			
Lack of Fit	0.4109		0.9686	not significant	0.9248		0.2313	not significant
Pure Error	2.62				0.4607			
Cor Total	62.32				64.75			

*Results for 2450MHz
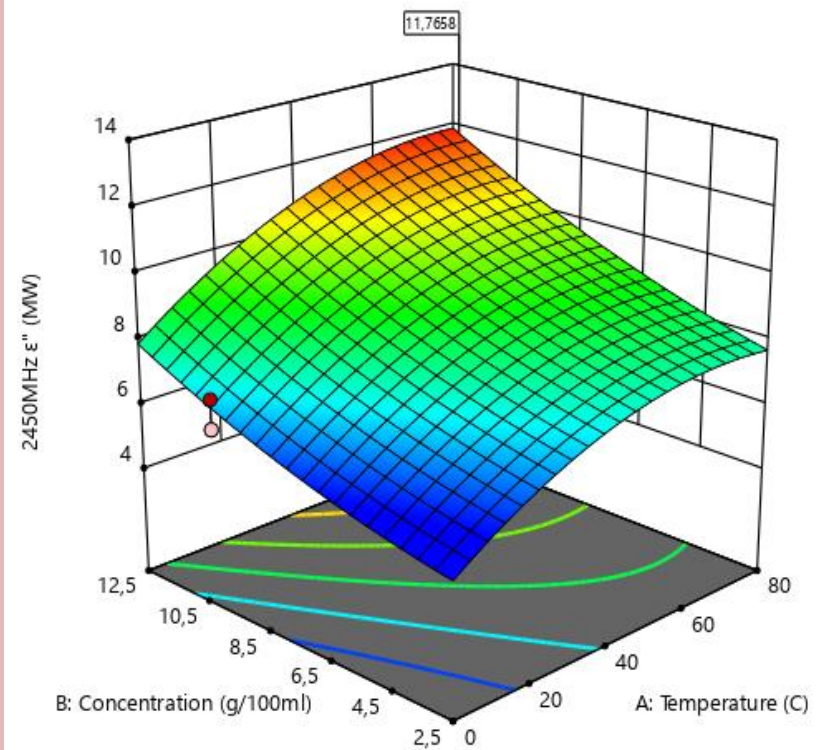
Influence of concentration and temperature on maximum *ε"*

Conventional VS Microwave
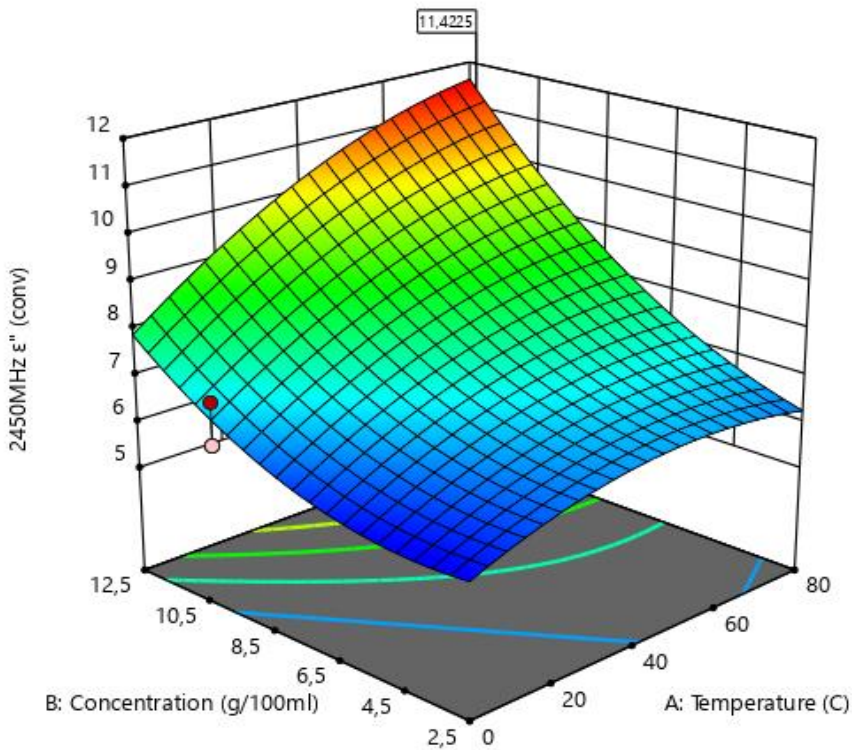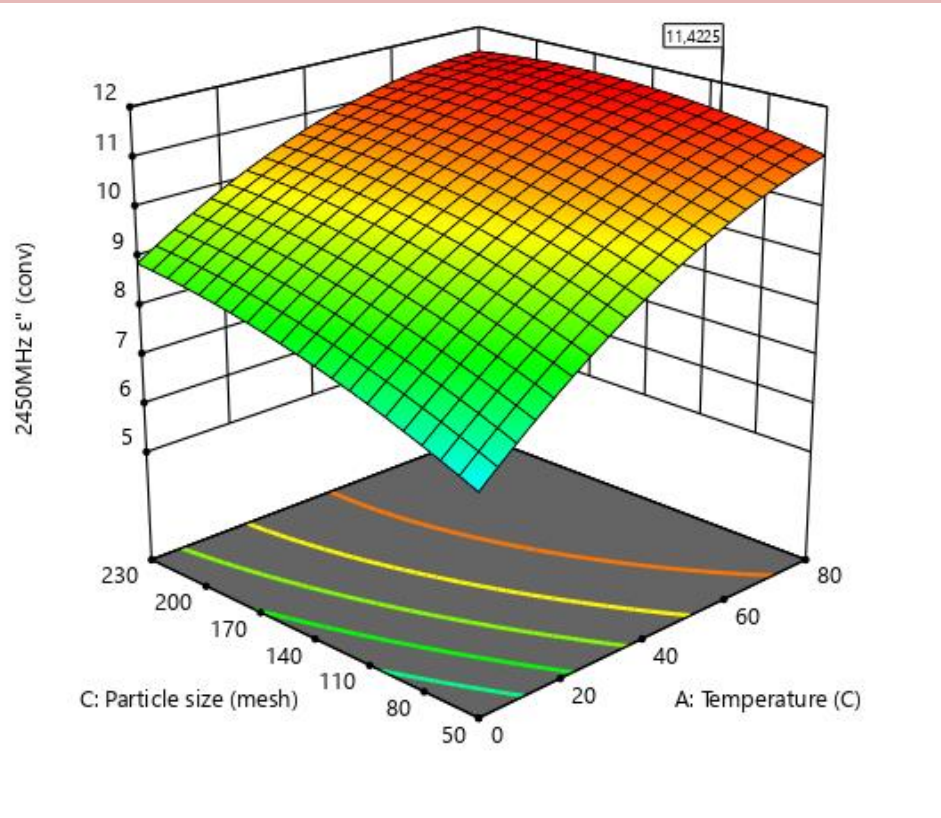

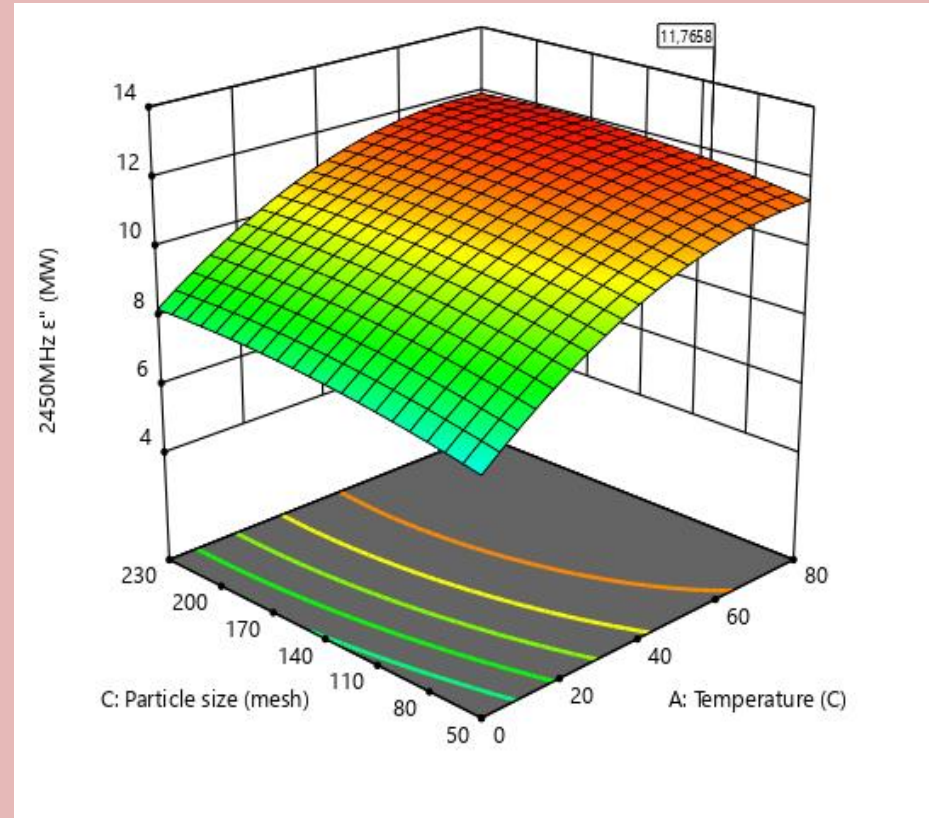11.42   11.76

Particle size 100 mesh (149 μm)

Influence of particle size and temperature on maximum ε''

Conventional VS Microwave

11.42   11.76
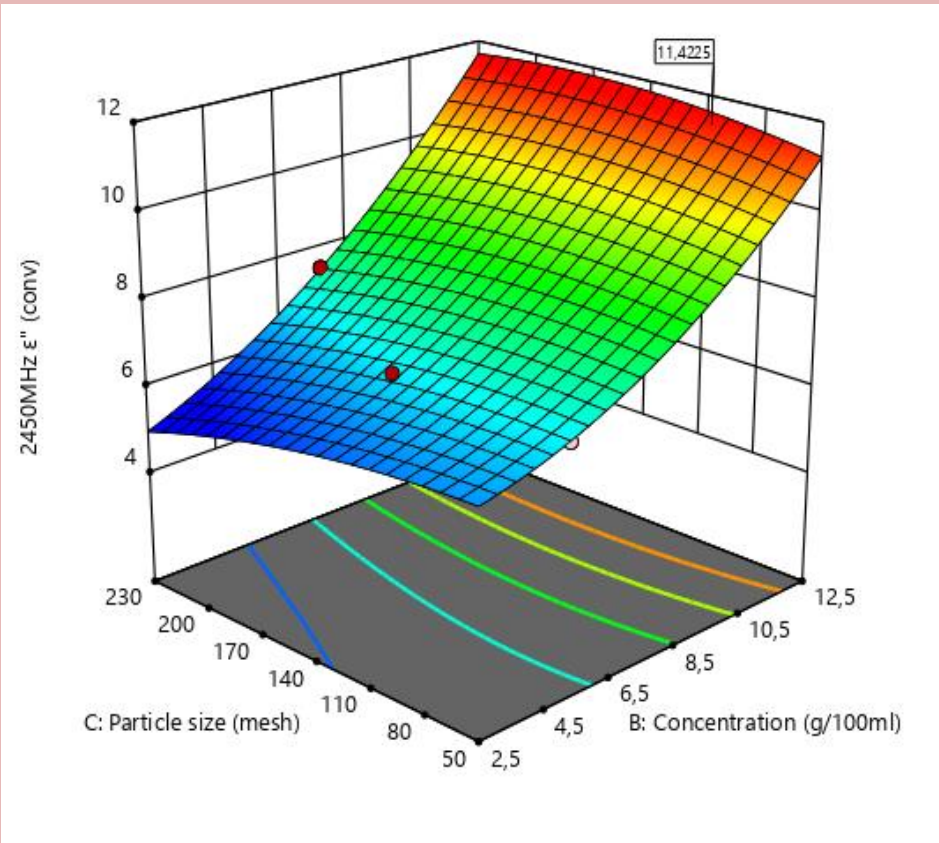
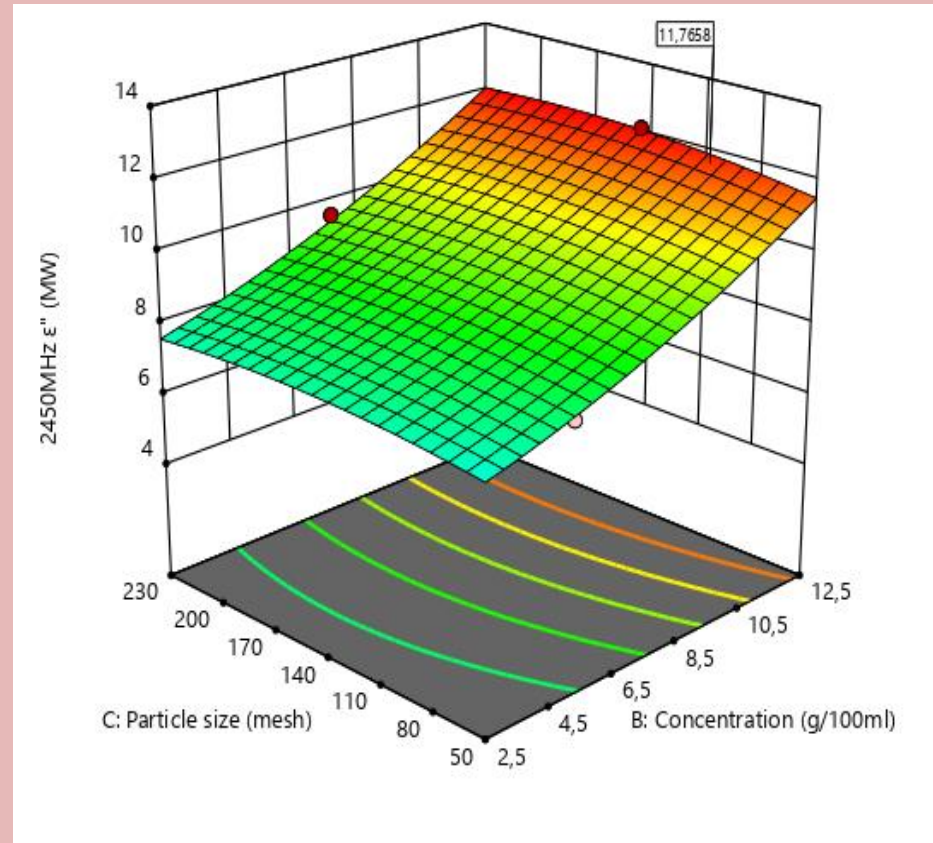*Concentration 12.28 %*

Influence of particle size and concentration on maximum ε"

Conventional VS Microwave

11.42   11.76

Temperature 80℃

pH and particle size effects on ε''

Source	Sum of Squares	Coefficients	p-value	
Model*	307.40		< 0.0001	significant
A-Particle size	65.84	-2.96	< 0.0001	
B-pH	*130.35*	*+4.29*	*< 0.0001*	
AB	5.47	+1.15	0.0457	
A²	1.25	+0.72	0.3006	
B²	46.16	-4.12	< 0.0001	
Residual	10.52			
Lack of Fit	9.22		0.0767	not significant
Pure Error	1.30			
Cor Total	317.92			

*Constant parameters : Concentration =*10% (w/v), particle size= 100 mesh (149 µm)*
*Results for 2450MHz

# Influence of pH and particle size on maximum ε''
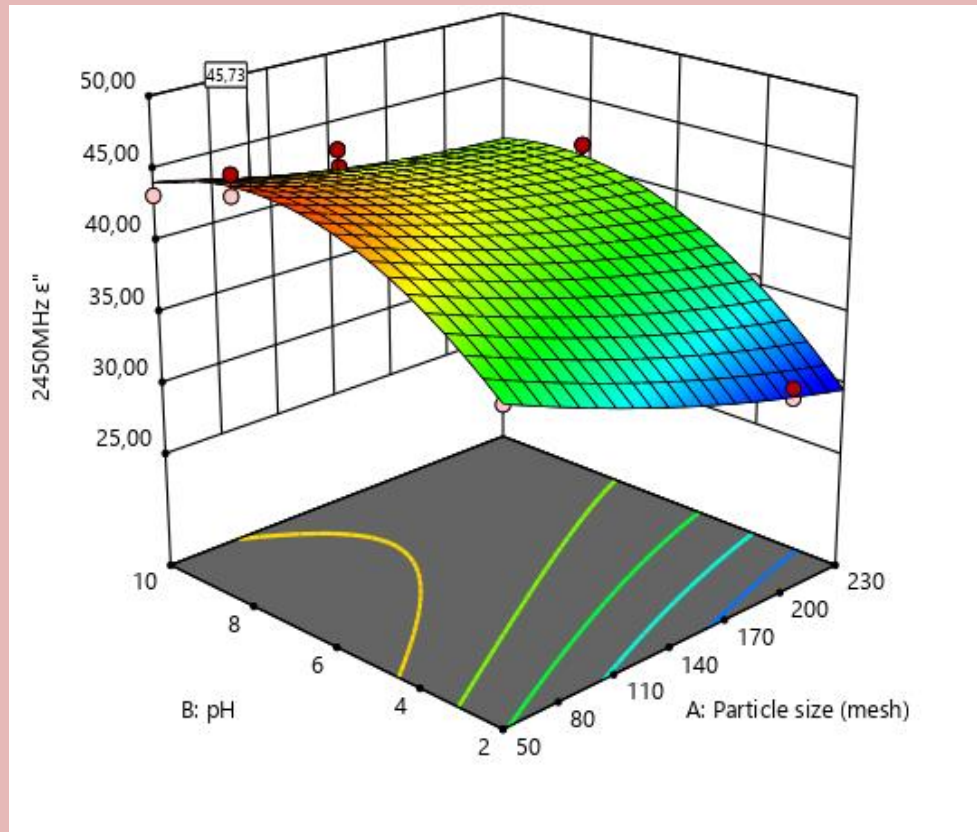
30.52 – 46.44

45.73

Sugar and salt concentration effects on ε''

Source	Glucose + Sodium chloride				Sucrose + Sodium chloride			
	Sum of Squares	Coefficients	p-value		Sum of Squares	Coefficients	p-value	
Model*	443.49		< 0.0001	significant	131.86		< 0.0001	significant
A-Sugar concentration	1.27	+0.52	0.3638			+0.19	0.3331	
B-Salt concentration	*378.88*	*+8.84*	*< 0.0001*		*120.15*	*+4.65*	*< 0.0001*	
AB	1.35	+0.78	0.3500					
A²	0.0080	-0.06	0.9406					
B²	0.2846	+0.36	0.6586		2.05	-0.96	0.0075	
Residual	7.91	1.32			1.57			
Lack of Fit	7.39	1.85	0.1272	not significant	1.33		0.4500	not significant
Pure Error	0.5203	0.26			0.2471			
Cor Total	451.41				133.43			

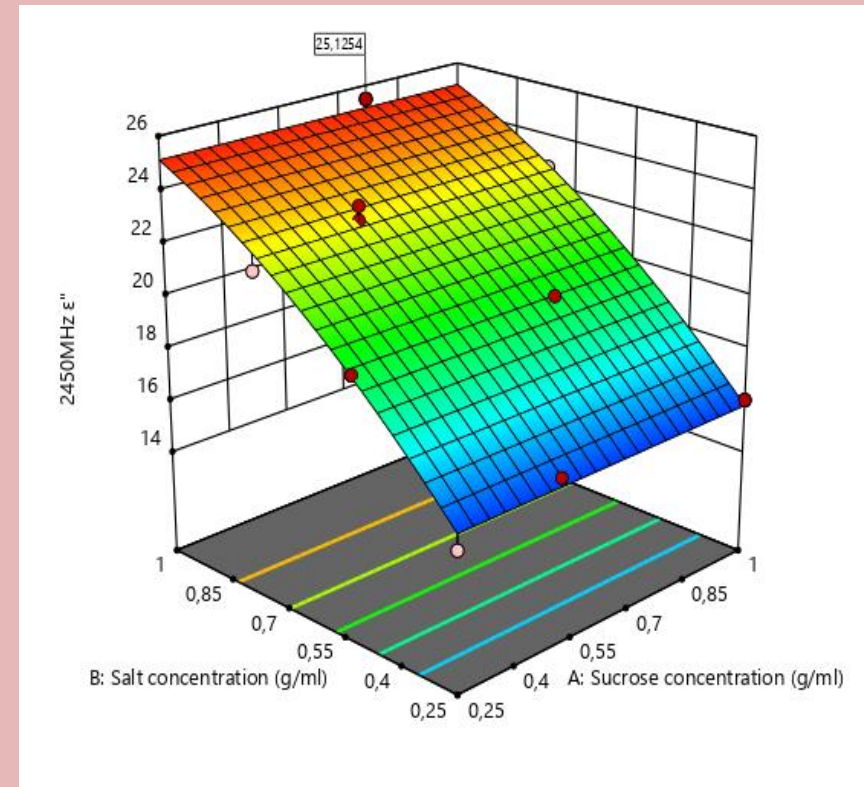*Constant parameters : Concentration =7.5% (w/v), particle size= 100 mesh (149 μm)
*Results for 2450MHz

Influence of salt and sugar concentrations on maximum ε"
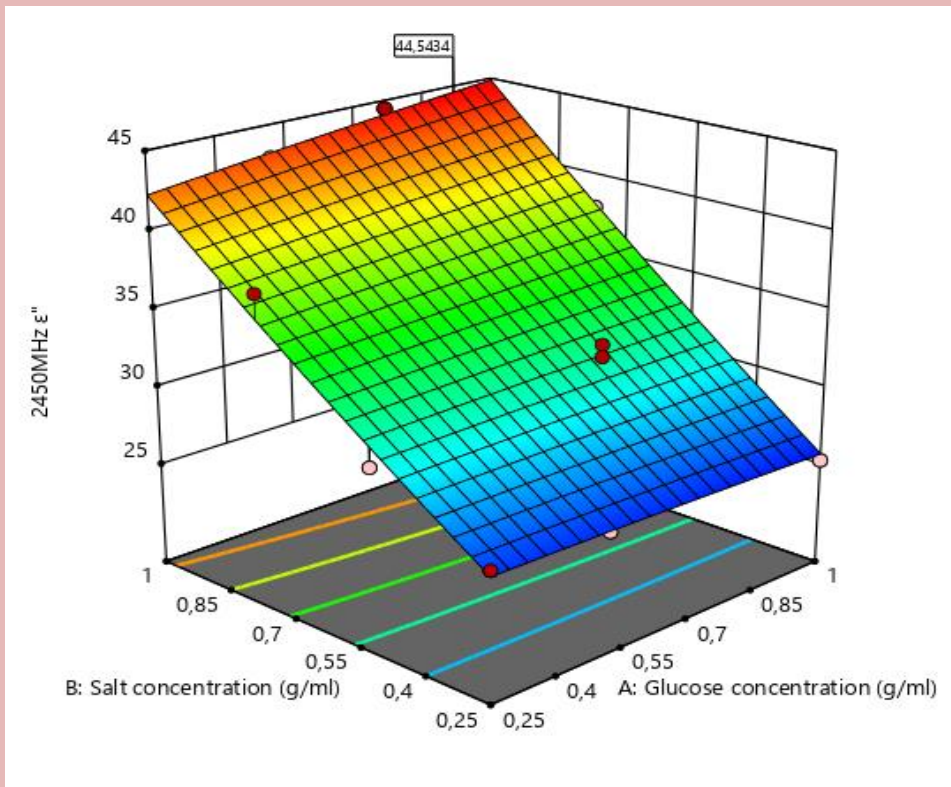
25.21-44.57

44.54

15.23-25.47

25.13

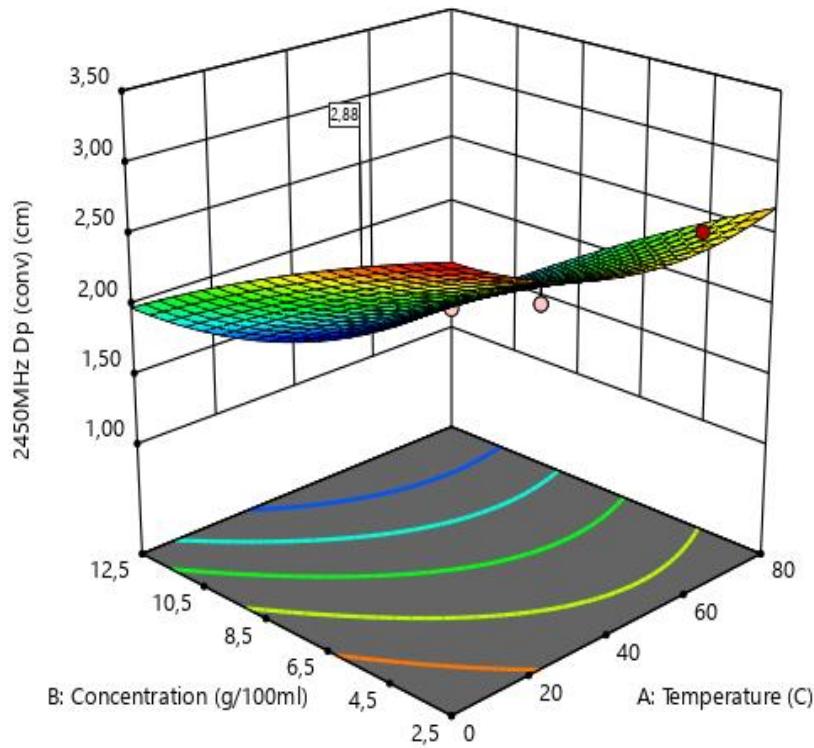# Temperature, concentration, particle size effects on *Dp*

| Source	Conventional heated				MW heated			
	Sum of Squares	Coefficients	p-value		Sum of Squares	Coefficients	p-value	
Model*	4.27		< 0.0001	**significant**	5.01		< 0.0001	**significant**
A-Temperature	*1.07*	*-0.34*	*< 0.0001*		*2.74*	*-0.54*	*< 0.0001*	
B-Concentration	*2.33*	*-0.52*	*< 0.0001*		*1.66*	*-0.43*	*< 0.0001*	
C-Particle size	0.0022	-0.02	0.7762					
BC	0.2010	-0.19	0.0153					
A²	0.3136	+0.29	0.0039		0.7774	+0.45	< 0.0001	
Residual	0.3692				0.2517			
Lack of Fit	0.1611		0.8716	**not significant**	0.1823		0.4497	**not significant**
Pure Error	0.2080				0.0694			
Cor Total	4.64				5.26			

 * Results for 2450MHz

Influence of concentration and temperature on maximum *Dp*
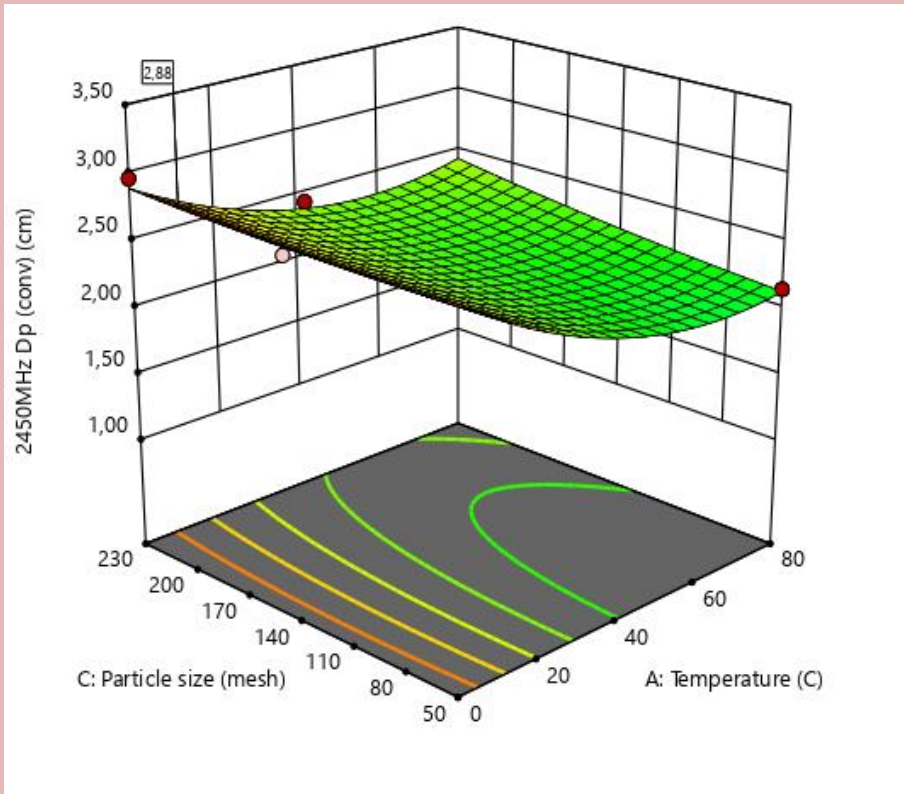
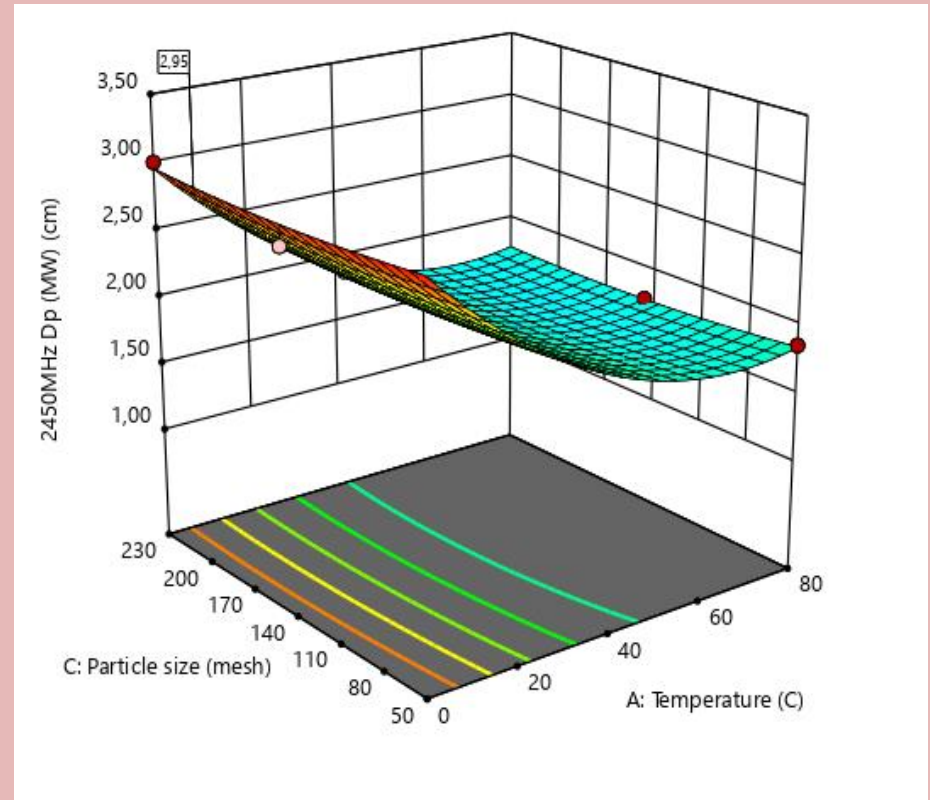## Conventional VS Microwave
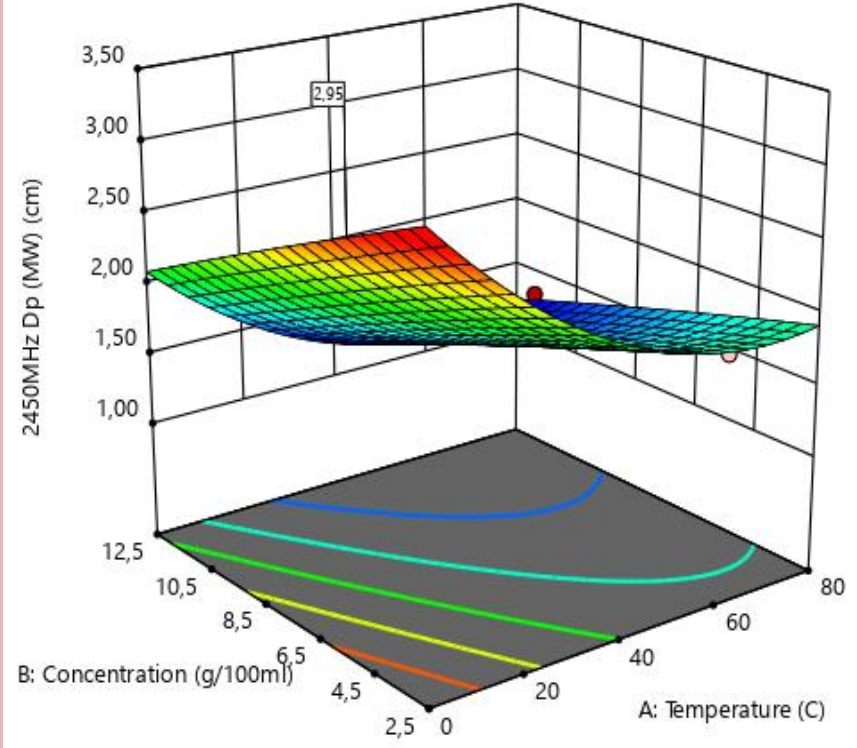
1.36-2.97
2.88

1.29-3.01
2.95

Particle size 200 mesh (74 μm)

Influence of particle size and temperature on maximum *Dp*
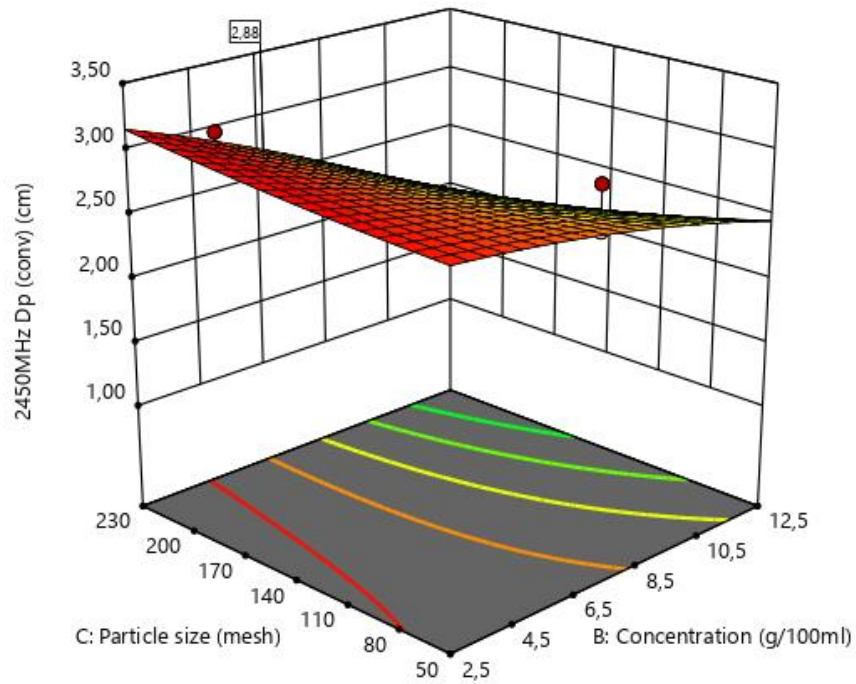
Conventional VS Microwave
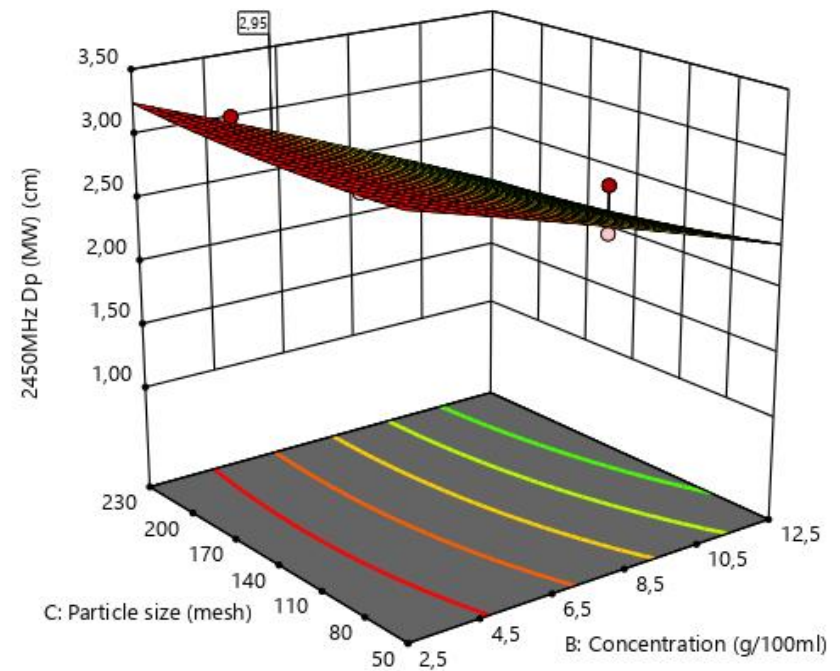

1.36-2.97
2.88

1.29-3.01
2.95

Concentration 5%

Influence of particle size and concentration on maximum *Dp*

Conventional VS Microwave

1.36-2.97

2.88

1.29-3.01

2.95

Temperature 0℃

pH and particle size effects on *Dp*

Source	Sum of Squares	Coefficients	p-value	
Model*	0.0390		< 0.0001	**significant**
A-Particle size	*0.0033*	*+0.02*	*< 0.0001*	
B-pH	*0.0215*	*-0.06*	*< 0.0001*	
AB	0.0012	-0.02	0.0006	
A²	0.0001	-0.01	0.1269	
B²	0.0070	+0.05	< 0.0001	
Residual	0.0005			
Lack of Fit	0.0004		0.1757	**not significant**
Pure Error	0.0001			
Cor Total	0.0395			

*Constant parameters : Concentration =*10% (w/v), particle size= 100 mesh (149 µm)*
*Results for 2450MHz

# Influence of pH and particle size on maximum *Dp*
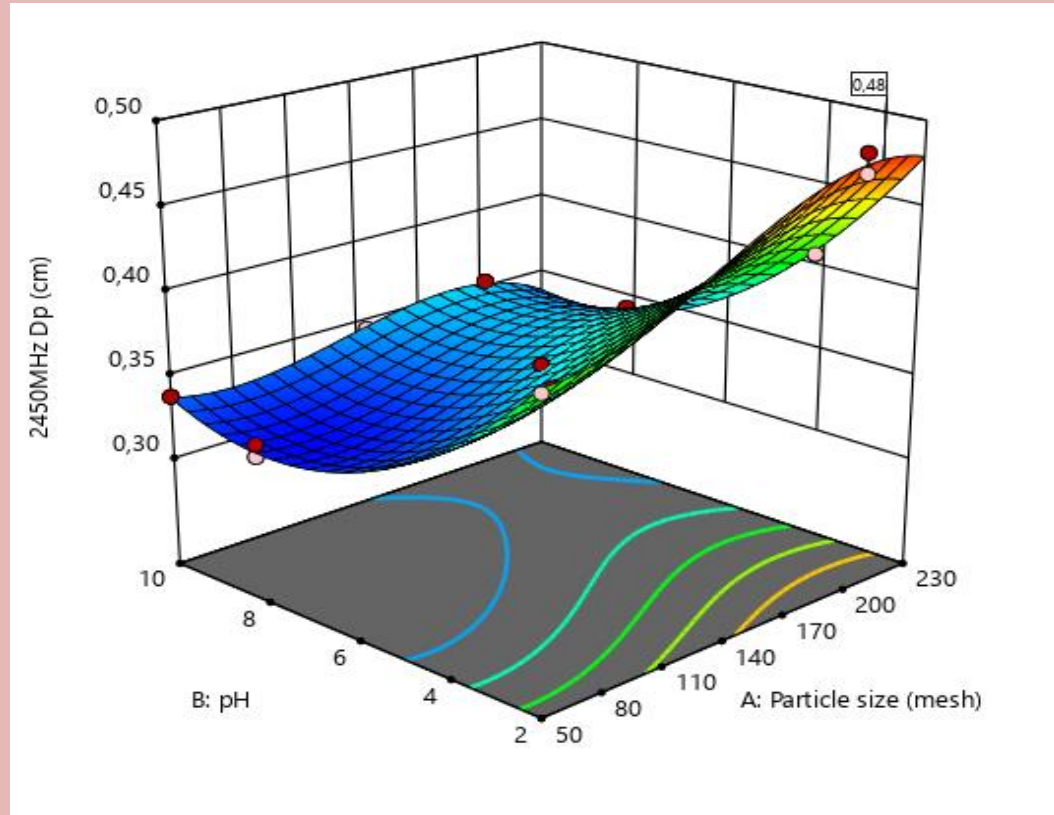
0.32-0.49

0.48

Sugar and salt concentration effects on *Dp*

Source	Glucose + Sodium chloride				Sucrose + Sodium chloride			
	Sum of Squares	Coefficients	p-value		Sum of Squares	Coefficients	p-value	
Model*	0.0709		< 0.0001	**significant**	0.2232		< 0.0001	**significant**
A-Sugar concentration	*0.0038*	*-0.03*	*0.0244*					
B-Salt concentration	*0.0662*	*-0.11*	*< 0.0001*		*0.1840*	*-0.1819*	*< 0.0001*	
B²					0.0142	+0.0799	0.0001	
Residual	0.0047				0.0031			
Lack of Fit	0.0045		0.1288	**not significant**	0.0027		0.3591	**not significant**
Pure Error	0.0002				0.0004			
Cor Total	0.0756				0.2263			

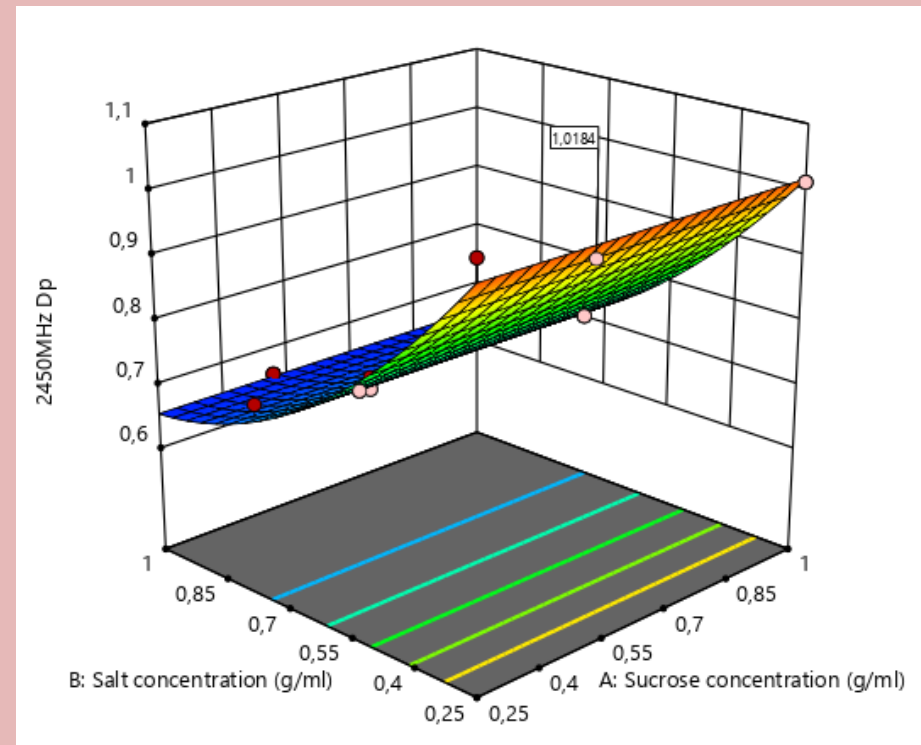*Constant parameters : Concentration =7.5% (w/v), particle size= 100 mesh (149 μm)
*Results for 2450MHz

Influence of salt and sugar concentration on maximum *Dp*
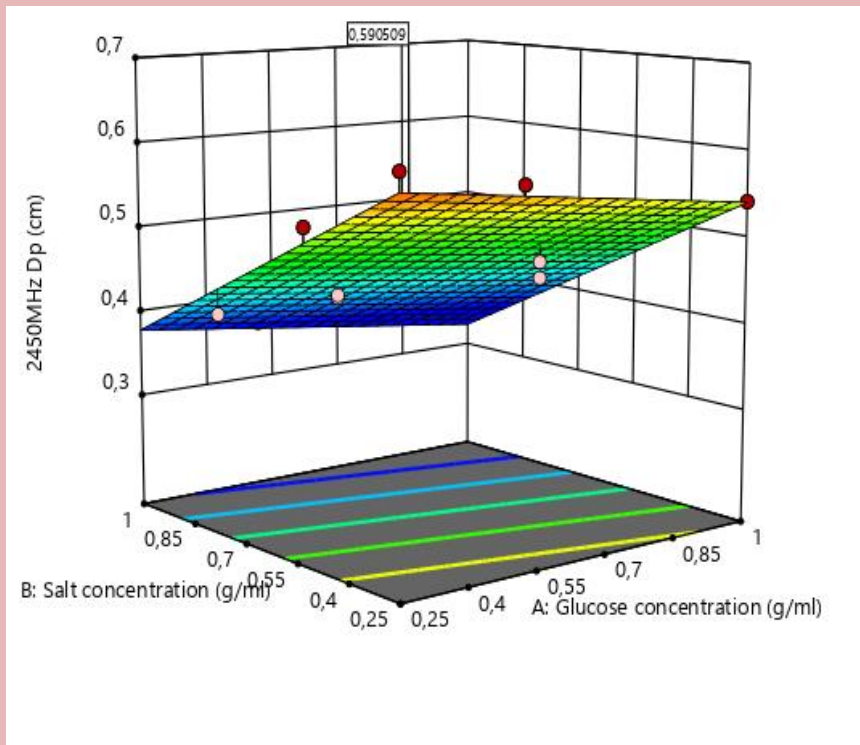
0.37-0.61

0.59

0.64-1.05

1.02

Optimum conditions for ε" and Dp

	Conventional	Microwave		Conventional	Microwave
Maximum ε"	**11.42**	**11.76**	**Maximum Dp**	**2.99**	**2.99**
T °C	80		T °C	6	
C %	12.28		C %	2.5	
Ps mesh	100		Ps mesh	200	
Maximum ε"	**45.73**		**Maximum Dp**	**0.48**	
pH	7.5		pH	2	
Ps mesh	50		Ps mesh	200	
Maximum ε"	**44.54**		**Maximum Dp**	**0.59**	
Glucose %	0.91		Glucose %	0.27	
Salt %	1		Salt %	0.25	
Maximum ε"	**25.13**		**Maximum Dp**	**1.02**	
Sucrose %	0.75		Sucrose %	0.5	
Salt %	1		Salt %	0.25	

ε'	Adj-R²	Pred-R²	Significant effects	
T&C&Ps (conventional)	0.94	0.78	temperature	
T&C&Ps (microwave)	0.94	0.85	temperature	
pH&Ps	0.99	0.94	pH	particle size
Salt+Glucose	0.95	0.86	salt	glucose
Salt+Sucrose	0.91	0.87		
ε''				
T&C&Ps (conventional)	0.91	0.84	concentration	
T&C&Ps (microwave)	0.96	0.91	concentration $\sim$	temperature
pH&Ps	0.95	0.93	pH	particle size
Salt+Glucose	0.97	0.87	salt	
Salt+Sucrose	0.99	0.98	salt	
Dp				
T&C&Ps (conventional)	0.91	0.85	concentration $\sim$	temperature
T&C&Ps (microwave)	0.94	0.92	temperature $\sim$	concentration
pH&Ps	0.98	0.96	pH	
Salt+Glucose	0.92	0.89	salt	glucose
Salt+Sucrose	0.98	0.97	salt	

Conclusion

- It is worth investigating SCP suspension prepared with combination of *coarser particles (>297μm), pH 7.5 solution , and addition of 1% NaCl.*

- pH&Ps interaction quite higher on *ε" than T&C&Ps* and salt&sugar effects.

- The influences of *ε', ε"* and *Dp* values at 915 MHz were found same with the parameters for 2450 MHz .

- All the responses in 915 MHz were higher than those at 2450 MHz.

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