

Novel synthesis of Biodegradable Polymer from Cucurbita Peels and Waste Newspaper Sheets



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Indian Pulp & Paper Technical Association

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INTRODUCTION

- Pumpkin peels are rich in pectin.
- They have been utilized to extract alcohol-insoluble polysaccharides (natural polymer).
- Environmental pollutants are reduced by Biodegradable polymers & release CO₂ & H₂O.
- Biodegradable polymer can be utilized for food packaging.
- Photodegradable plastic - degraded by sunlight.
- Oxidatively degradable plastic - degraded by oxidation.
- **Therefore, the study was undertaken to develop biodegradable films from pumpkin peels & newspapers.**



Pumpkin (Curcubita)



Dried Peels



Dried Pumpkin Peel Powder (a)

Bioplastic versus Conventional plastic

Bioplastic	Conventional plastic
➤ More sustainable	➤ Unsustainable
➤ Non-toxic	➤ Eco-toxic
➤ Less usage of energy	➤ More energy usage during production (65%)
➤ Eco friendly	➤ Increases global warming
➤ No harm to abiotic factors	➤ Leads to abiotic depletion
➤ Increases soil fertility	➤ Reduces soil fertility
➤ Recycling & destroying process difficult	➤ Recycling & destroying process is relatively easy

Material and Methods

Synthesis of biodegradable plastic film (B & C)

Sr. No.	Material	Amount
1	Dried pumpkin (Curcubita) peel powder	2 gm
2	Corn Starch	5 gm
3	Glycerol	3 ml
4	Citric Acid	1 gm
5	Gelatin	2 gm
6	Water	100 ml

- **Method:** Content mixed. RM raised 95-100 °C, maintained it for 1-1.5 Hr. Poured to a Petri plate. Dried.
- **Wt. of BP film (b) = 9.65 gm, Costing: 4.594 INR (Reference Costing Table)**
- Same process for BP film (C), filtration is applied.
- **Wt. of BP film (C) = 8.25 gm, Costing: 4.594 INR (Reference Costing Table)**

Biodegradable film (B and C)



RM poured on a Petri dish



Dried Bioplastic film (B)



RM poured on a petri dish after filtration



Dried Bioplastic film (C)

Synthesis of Bio-plastic from pumpkin peel and newspaper (D)

Sr. No.	Material	Amount
1	Dried pumpkin peel	2 gm
2	News paper	5 gm
3	Corn Starch	5 gm
4	Glycerol	3 ml
5	Citric Acid	1 gm
6	Gelatin	2 gm
7	Water	110 ml

- **Method:** Paper sludge and content mixed.
- RM raised to 130-140 °C, maintained for 1-1.5 Hr till slurry obtained.
- Poured onto a Petri plate. Dried it.
- **Wt. of BP film (D) = 10.58 gm**
- **Costing = 5.675 INR (Reference costing table)**

Bio-plastic from Newspaper pulp & Pumpkin peel (D)



Small pieces of Newspaper for making sludge



D: Dried bioplastic film without filtration

Synthesis of Bio-plastic from pumpkin peel and newspaper (E)

Cost cutting purpose

Sr. No.	Material	Amount
1	Dried pumpkin peel	5 gm
2	News paper	10 gm
3	Corn Starch	1 gm
4	Glycerol	2 ml
5	Vinegar	1 gm
6	Water	10 ml

- **Method:** Paper sludge and content mixed.
- RM raised to 130-140 °C, maintained for 1-1.5 Hr till slurry obtained.
- Poured onto a Petri plate. Dried it.
- **Wt. of BP film (E) = 15.86 gm, Costing = 4.74 INR (Reference Costing Table)**

Costing of Biodegradable polymer (as per wt. obtained)

Raw Material	Price/50 gm	Quantity for Film B & C	Price For Film B & C (in Rs.)	Quantity for Film D	Price for Film D (in Rs.)	Quantity for Film E	Price for Film E (in Rs.)
Pumpkin Peel Powder	30 Rs.	2gm	1.2	2gm	1.2	5gm	3
Corn Starch	2 Rs.	5gm	0.2	5gm	0.2	1gm	0.04
Glycerine	40 Rs.	3gm	2.4	5gm	4	2gm	1.6
Gelatine	18.5 Rs.	2gm	0.74	-	-	-	-
Citric acid	2.7 Rs.	1gm	0.054	-	-	-	-
Vinegar	2.5 Rs.	-	-	5gm	0.25	1gm	0.05
Waste News Paper	0.25 Rs.	-	-	5gm	0.025	10gm	0.05
Total Cost (in INR – Rs.)			4.594		5.675		4.74

Note: Prize of Raw Material taken from India mart

Comparison of final costs of synthesized biodegradable films

FILM SAMPLE	Wt. Obtained (gm)	Costing (In Rs.)	Costing per Kg (In Rs.)
B	9.65	4.594	476
C	8.25	4.594	556
D	10.58	5.675	536
E	15.86	4.74	298

RESULT AND DISCUSSION

- **Water Absorption Test:** Biodegradable Polymers dipped in water for 24 hours at RT.
- BP film with pumpkin peel with filtration (c) had the maximum water uptake.

Result of water absorption of BP films

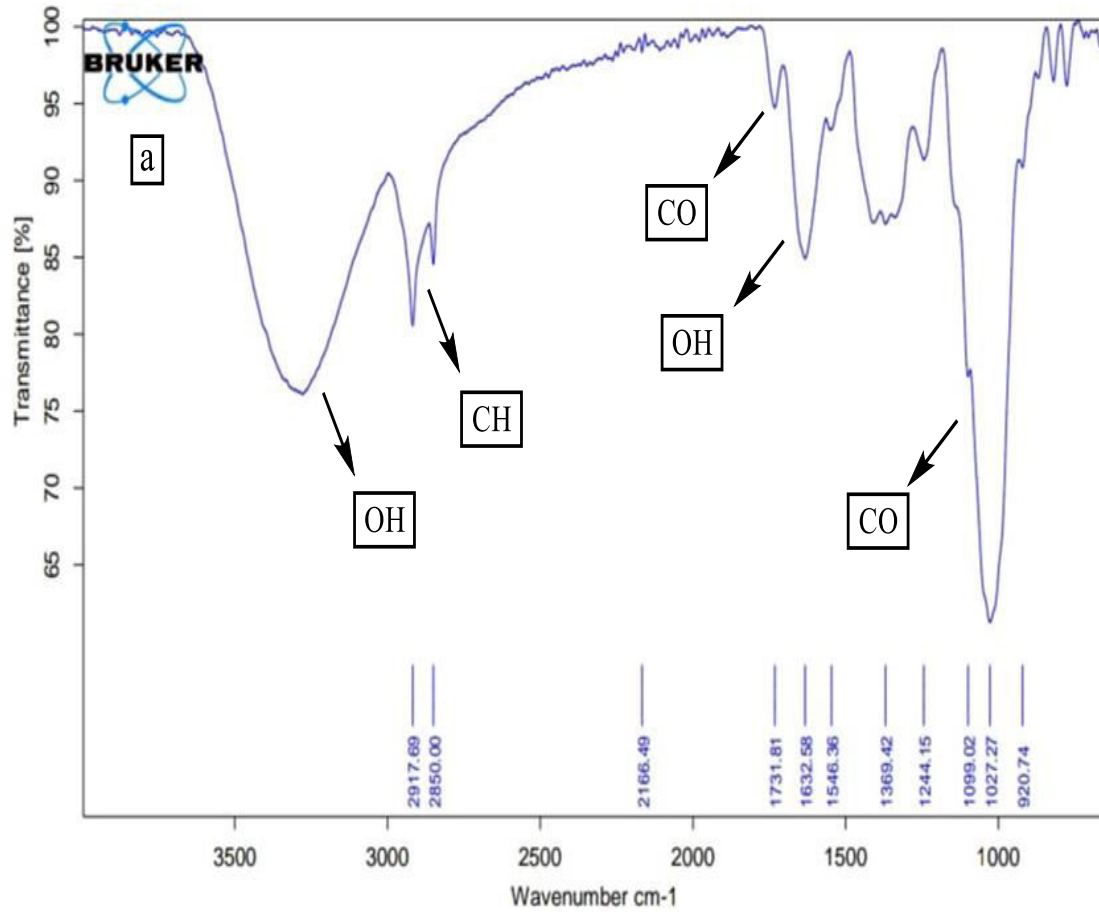
Sample BP Film	Initial Weight BP film (gm)	Final Weight BP Film (gm)	Water Absorption Water uptake (%)
Pumpkin peel (b)	0.31	0.46	48.38
Pumpkin peel with filtration (c)	0.21	0.36	76.19
Pumpkin peel- Newspaper (d)	0.22	0.34	54.54
Pumpkin peel - Newspaper (costing purpose - E)	0.23	0.33	43.47

- **Biodegradability Test:** Biodegradable Plastics decayed naturally by occurring microorganisms.
- Decomposition in certain situations, such as compost, soil, or aquatic settings.
- BP films passed in soil for several days and measured their degradation.
- The synthesized biodegradable films are degraded in the soil as shown in the table.

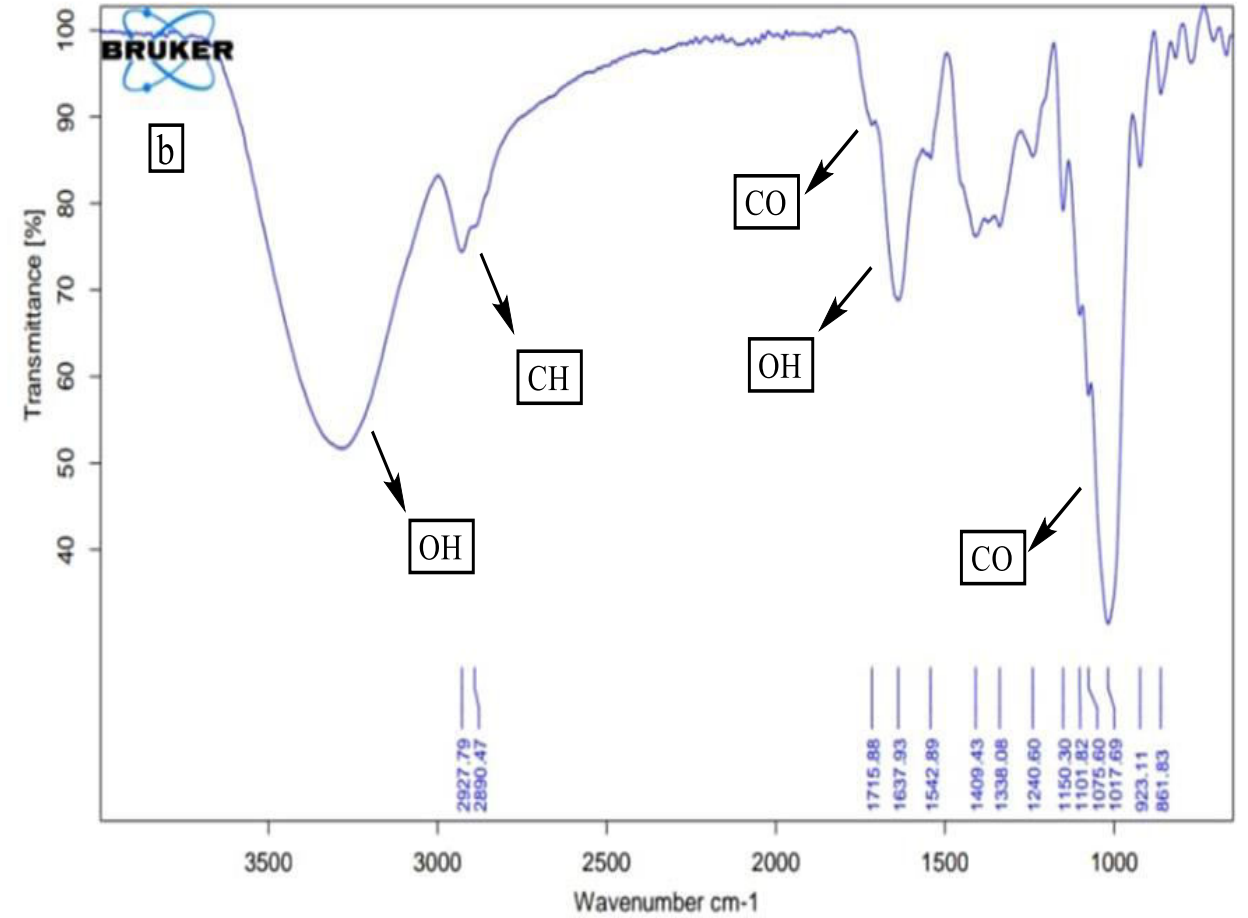
Biodegradability test in soil

Sample BP films	Initial Weight BP film	Weight After 7 days (gm)	Weight After 10 days (gm)	Weight After 15 days (gm)
Pumpkin peel (b)	0.995	0.82	0.70	0.56
Pumpkin peel with filtration (c)	1.704	1.45	0.92	0.66
Pumpkin peel- Newspaper (d)	1.820	1.21	0.78	0.32
Pumpkin peel- Newspaper (costing cutting) (E)	1.786	1.39	1.21	0.86

IR Analyses

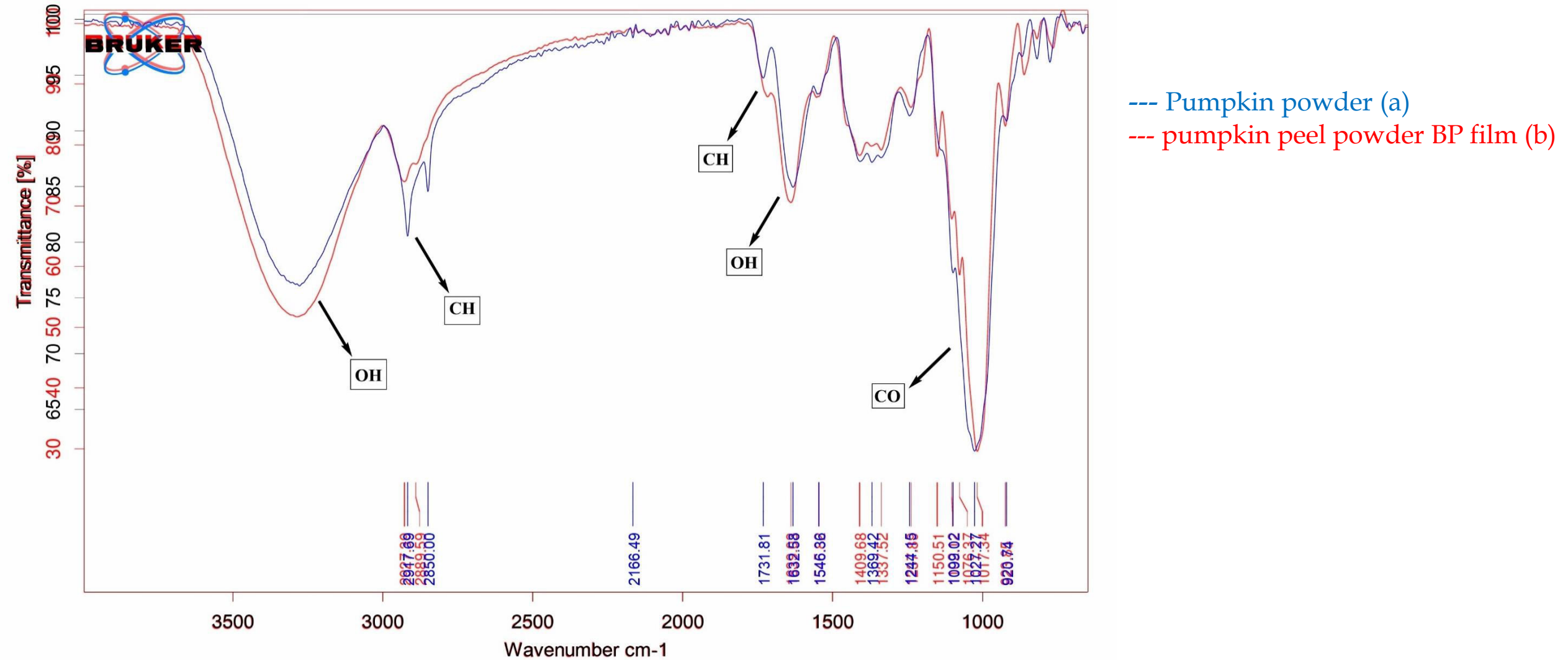


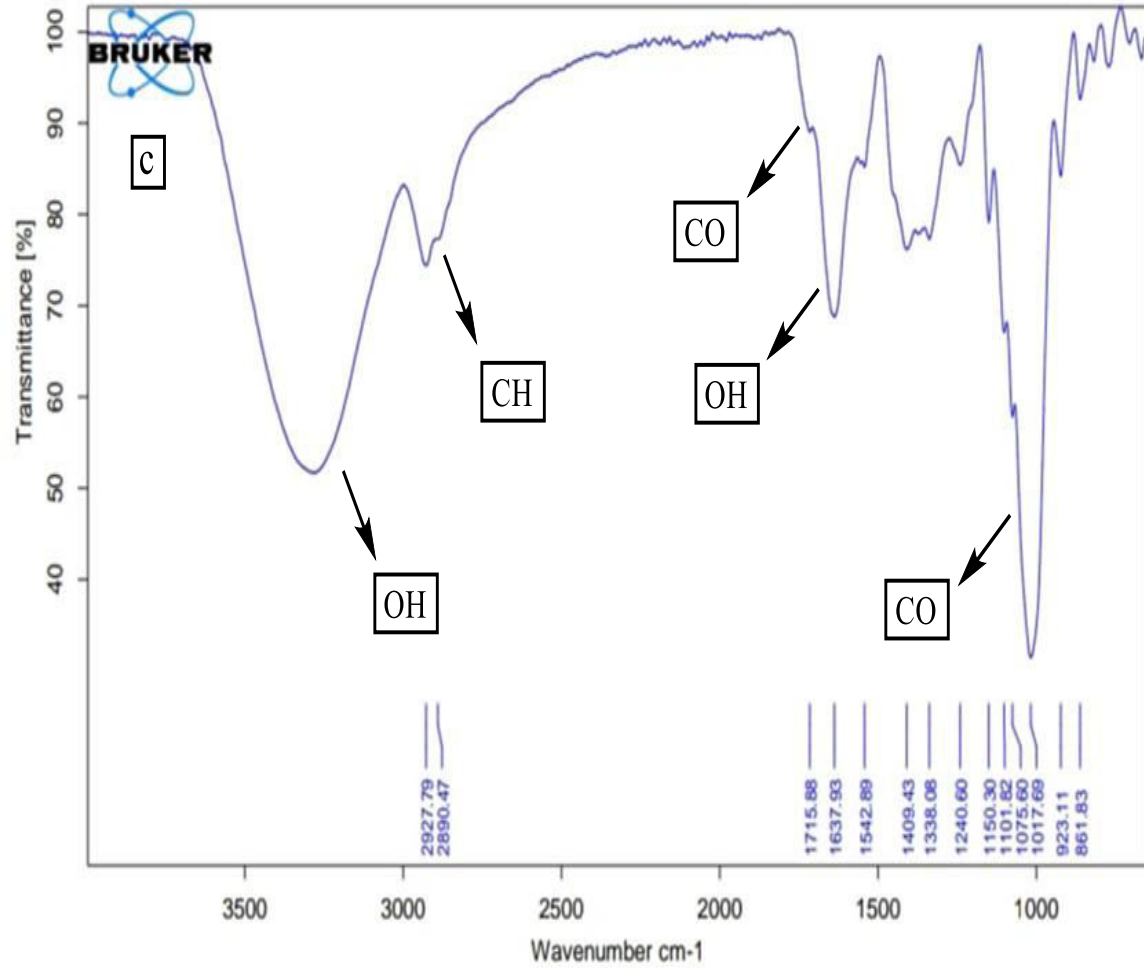
(a) Pumpkin Pill Powder



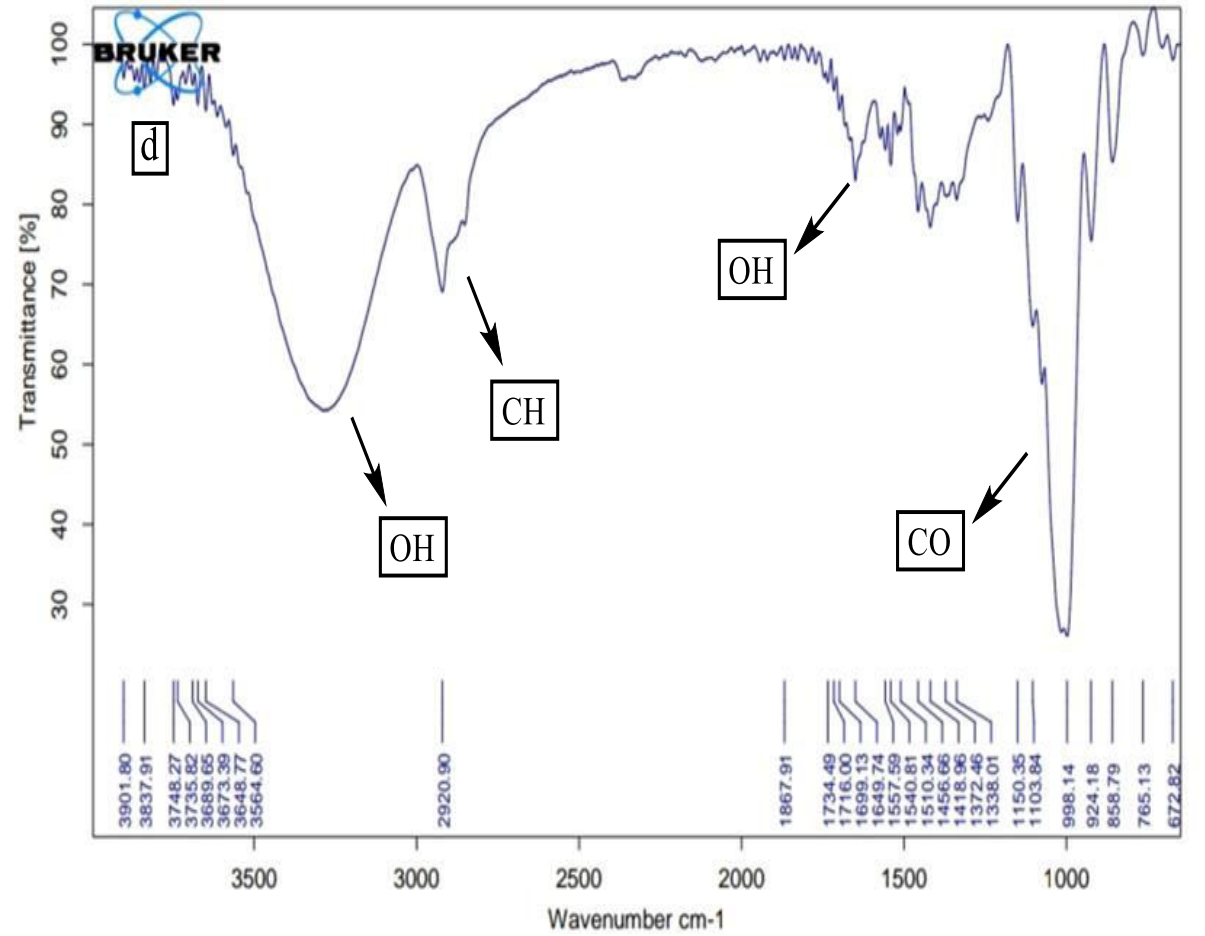
(b) pumpkin peel powder BP film

Comparison of IR data between Pumpkin powder (a) and pumpkin peel powder BP film(b)



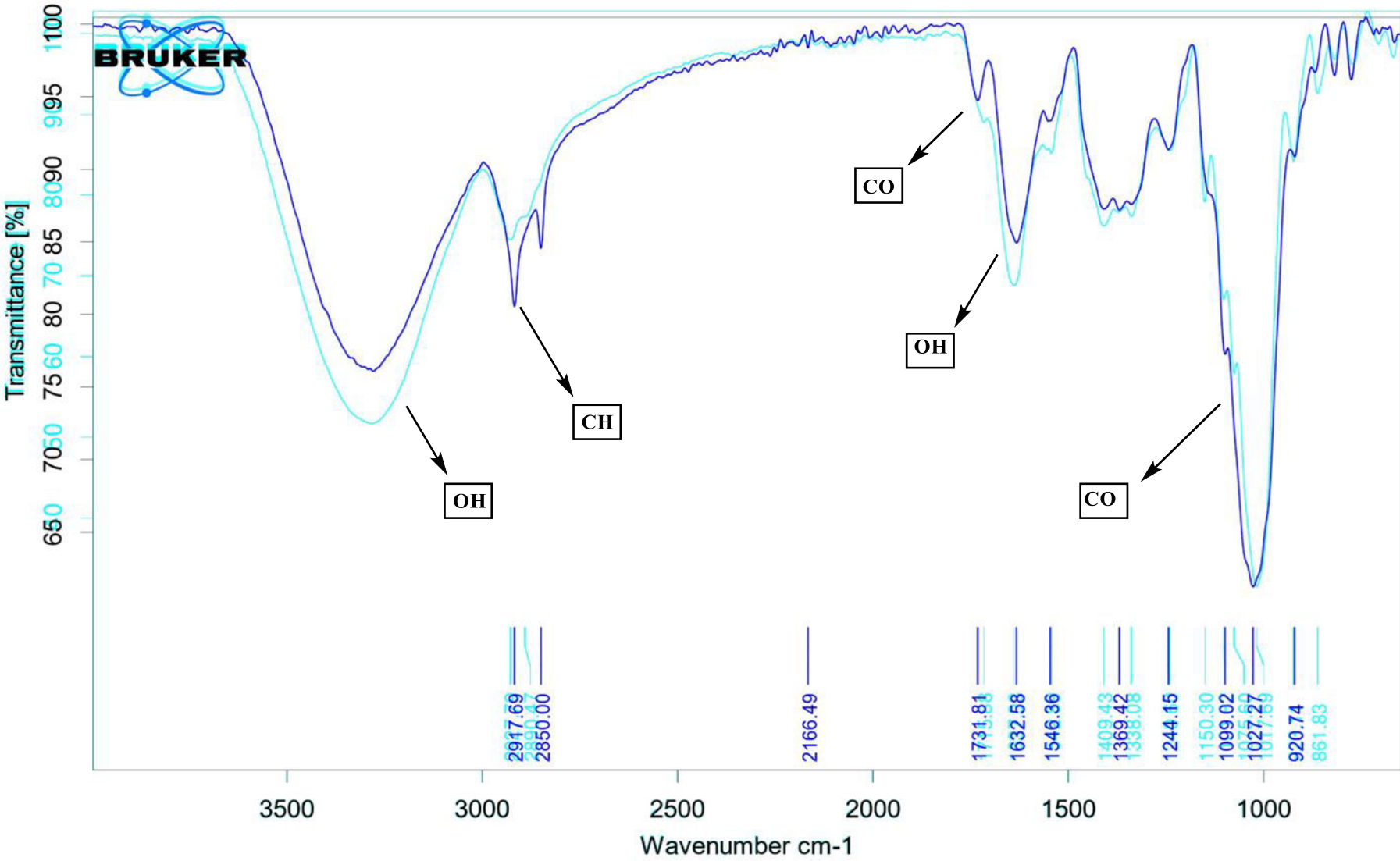


(c) Bio-plastic from pumpkin peel
(with filtrate)



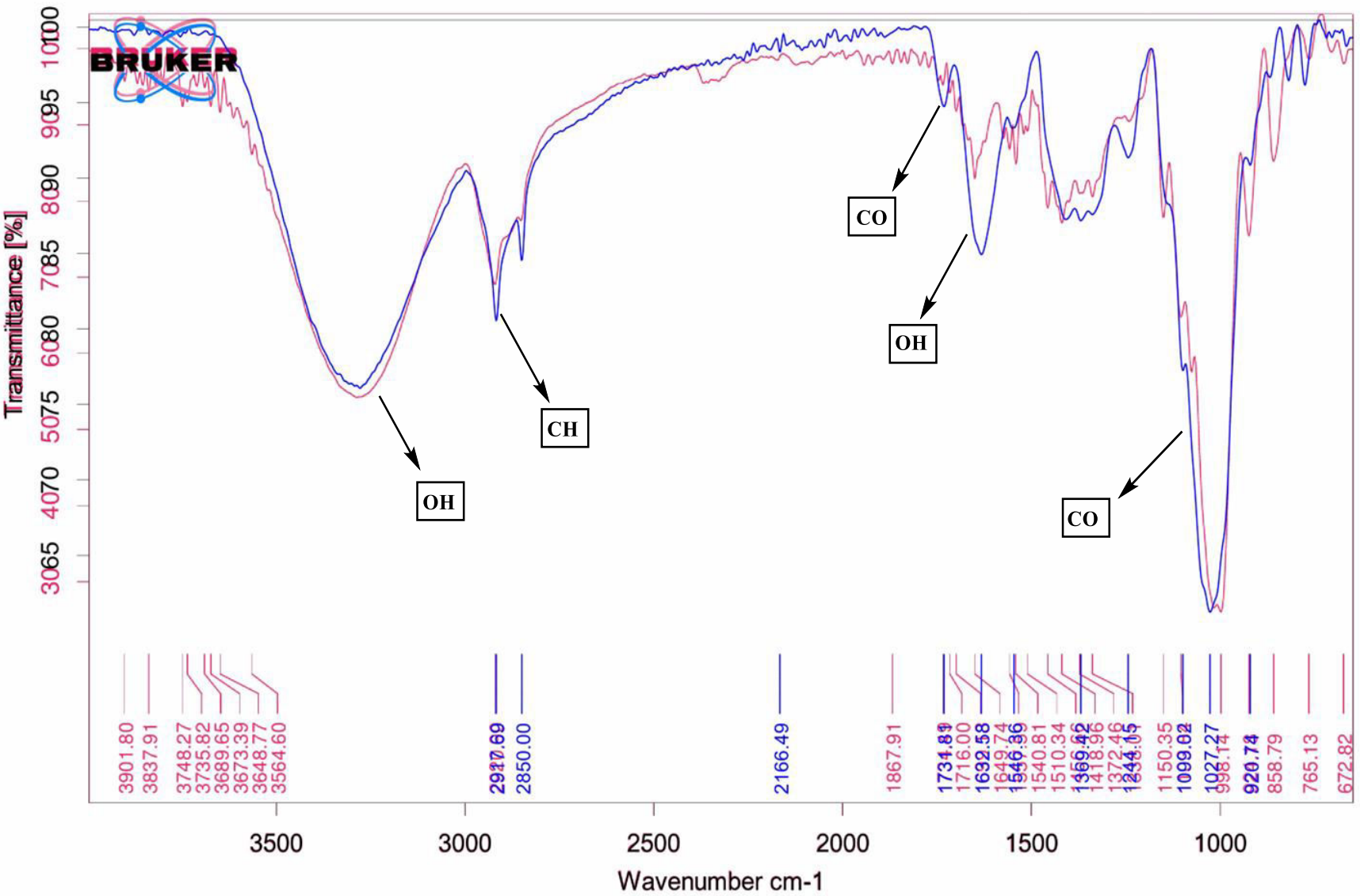
(d) Bio-plastic from pumpkin peel and newspaper mixture
(without filtrate)

Comparison of IR DATA between Pumpkin powder (a) and Bio-plastic from pumpkin peel (with filtrate) (c)



- Pumpkin powder (a)
 - Bio-plastic from pumpkin peel (with filtrate) (c)

Comparison of IR Data of Pumpkin powder (a) & Bio-plastic from pumpkin peel and newspaper mixture (d)



-- Pumpkin powder (a)
 -- Bio-plastic from pumpkin peel and newspaper mixture (d)

Challenges

- Technology requires a bulk of pumpkin peel powder.
- “How to generate the bulk of pumpkin peel powder at a relatively cheaper cost and availability.”
- Research going on the above point.
- The collaboration of industry is needed for bulk production.

Conclusion

- Biodegradable films from pumpkin peel & newspaper were successfully formed.
- Their biodegradability in aqua as well as soil & proved biodegradable.
- IR analyses confirm pumpkin (Cucurbita) peel powder's insertion into bioplastic film.
- The synthesized biodegradable plastics have wide commercial scope.
- It's high time now, as we need to switch to other alternatives for saving the environment.
- They should be suitable, harmless, useful, and economical to improve the environmental condition.
- As fruit & vegetable peels are discarded, they can be incorporated with starch to give bioplastics.
- This process can be "Best out of Waste".



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Thank You



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