SCIENTIFIC DATA BASE

Tables & Figures

for SPORADIC's 2023 Field Experiment

in Nouvelle-Aquitaine

Table of Content

Figure 1. Type of agricultural and agro-industrial lignocellulosic biomass residues (LBR)

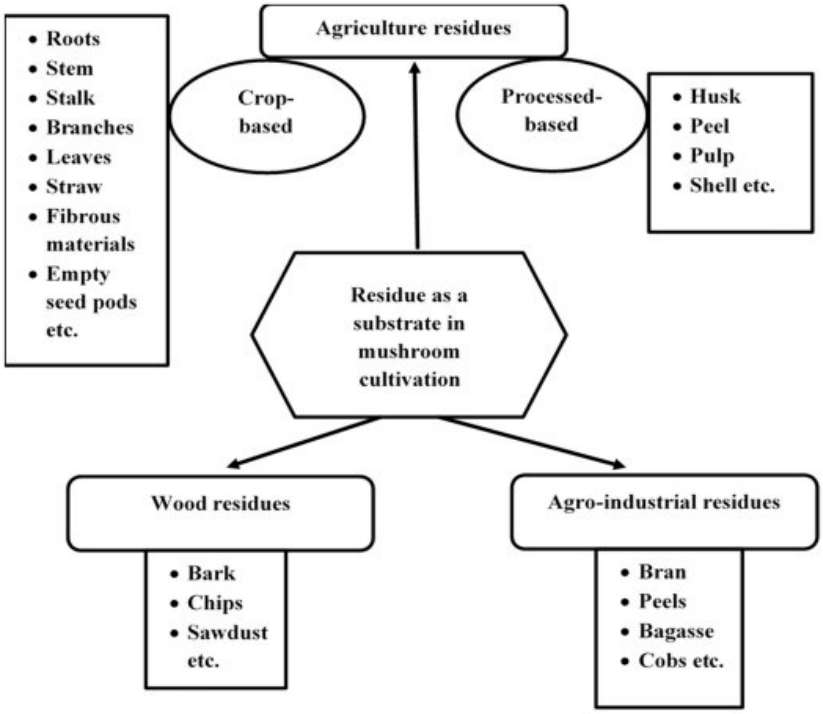


Figure 2. Circular economy model: EkoFungi's "Waste to Taste"

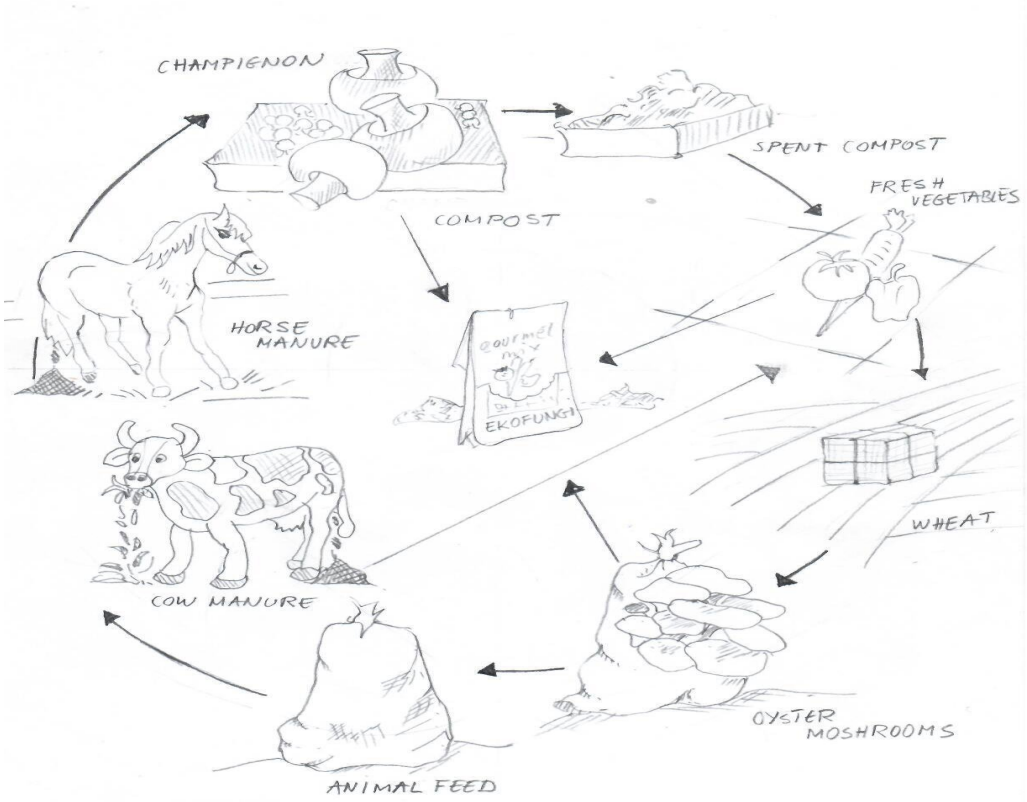


Table 1.1 LBR (straw and hay) that may be used for the cultivation of the Pleurotus ostreatus mushroom[1]

Organic matter	Dry matter %	NEL MJ/kg	Crude protein %	Crude fiber %	NDF	ADF	Cellulose %	Lingin %
Wheat, straw	89	4.0	3.6	41.6	85	54	39	14
Barley, straw	91	4.5	4.3	42.0	80	59	37	11
Oats, straw	92	4,6	4.4	40.5	70	47	40	14
Alfalfa, hay	90	5.1	15	29.0	50	37	28	10
Bahiagrass, hay	91	4.0	9.5	33.0	73	38	31	6
Fescue, hay	92	4.4	9.2	32.6	70	42	34	7
Bermudagrass, hay	93	3.9	8.0	36.0	78	43	33	7
Bluegrass ,hay	90	5.2	9.5	32.2	69	40	34	6
Brome, hay	89	2.9	10.0	37.0	68	43	36	3
Timothy, hay	88	5.0	7.8	32.5	70	40	34	7
Peanut, hay	91	5.1	10.8	33.2	70	41	35	8
Orchardgrass, hay	91	5.0	8.4	37.1	72	45	39	9
Clover, hay	89	5.1	16.0	28.8	46	36	28	8
Pangolagras, hay	91	3.6	5.5	38.0	77	46	37	7
Ryegrass, hay	83	5.0	5.5	36.3	69	45	36	9
Napiergras, hay	90	4.9	7.8	39.0	75	47	35	14
Sorghum, hay	91	5.2	8.0	36.0	68	42	35	6

Table 1.2. LBR (industrial byproducts) that may be used for the cultivation of Pleurotus ostreatus mushroom

Organic matter	Dry matter %	NEL MJ/kg	Crude protein %	Crude fiber %	NDF %	ADF %	Cellulose %	Lingin %
Cotton, hulls	91	3.9	4.1	47.8	90	73	59	24
Peanut, hulls	91	1.7	7.8	62.9	74	65	40	23
Rice, hulls	92	0.7	3.3	42.9	82	72	33	16
Soybean, hulls	91	7.4	12.1	40.1	67	50	46	2
Oats, hulls	92	3.1	3.9	33.4	78	42	30	8
Safflower, mech. ext.	91	5.6	22.1	32.5	58	41	27	14
Cobs, ground	90	4.6	3.2	36.2	89	35	28	7
Grape marc, pomace	91	2.9	13	31.9	55	54	48	35
Sawdust, salt cedar	90		3.8	40.5	78	61	44	17
Coffee pulp, dehydrated	92		11.3	18.5	49	46		9
Coffee, hulls	88		9.4	36.0	62	51		16
Instant coff. byproducts	91		10.9	44.0	71	66		23

1 Courtesy of an EkoFungi's study, by Adamović et al., 1998, pp.360-62

Table 2.1 Chemical properties (dry weight basis) of LBR used as substrate for mushroom cultivation[2]

Lignocellulosic biomass	Cellulose (%)	Hemicellulose (%)	Lignin (%)	Cellulose/lignin ratio	N (%)	C/N ratio	References
Crop-based residue							
Rice straw	32.0–47.0	19.0–27.0	5.0–24.0	2.20–3.24	1.0–3.0	33–60	Dotaniya et al., 2016; Khir & Pan, 2019; Millati et al., 2019
Wheat straw	31.0–38.5	27.2–37.6	5.6–11.6	3.60–4.47	0.4–0.8	80–125	Philippoussis, 2009; Koutrotsios et al., 2014
Corn stover	24.0–40.0	20.0–29.0	12.0–23.0	1.37–2.28	0.6–0.9	55–57	Philippoussis, 2009; NRCS, 2011; Dotaniya et al., 2016; Ruan et al., 2019
Corn stalk	38.7	30.4	4.8	8.06	0.8	50–93.2	NRCS, 2011; Atila, 2019
Processing-based residue							
Corncob	32.0–40.5	35.4–41.6	2.5–9.0	5.56–7.04	1.0	50–71.6	Philippoussis, 2009; NRCS, 2011; Koutrotsios et al., 2014; Sardar et al., 2017: Millati et al., 2019
Sugarcane bagasse	34.2–47.0	24.5–31	14.0–21.22	1.94–2.67	0.2–0.8	116–190	Philippoussis, 2009; Dotaniya et al., 2016; Sardar et al., 2017; Hernández et al., 2019
Rice husk	31.12–43.3	22.48–28.6	22.0–22.34	1.40–1.95	0.3–0.4	83–136	Thiyageshwari et al., 2018; Khir & Pan, 2019; Millati et al., 2019
Softwood sawdust	33.0–42.0	22.0–40.0	27.0–32.0	1.11–1.42	0.1	310–520	Philippoussis, 2009; Nhuchhen et al., 2014; Tarasov et al., 2018
Hardwood sawdust	38.0–51.0	17.0–38.0	21.0–31.0	1.46–1.96	0.1–0.2	150–450	Philippoussis, 2009; Menon & Rao, 2012; Tarasov et al., 2018

Table 2.2. Chemical composition of wheat straw and substrate for Pleurotus ostreatus (on 100% dry matter basis)

Indicator	Wheat straw %	Substrate for oyster mushroom %
Crude ash	6,47	7,95
Crude fat	2,00	3,25
Crude fiber	40,57	30,01
Crude protein	3,47	4,58
BEM	47,49	54,21
Ca, g/kg	2,07	5,53
P, g/kg	0,61	0,52

[2] For the complete Bibliography see Text document. A considerable amount is compiled from the recent work of Dhull (2022).

Table 3.1 Biological efficiency and chemical composition of some mushrooms cultivated on diverse LBR substrates

Lignocellulosic substrate	Mushroom species	Biological efficiency (%)	Chemical composition (%, dry weight)					References
			Crude protein	Carbohydrate	Fat	Crude fiber	Ash	
Wheat straw	*Pleurotus ostreatus*	77.26	15.22	73.75	2.54	18.99	8.49	Koutrotsios et al., 2019
	Pleurotus sajor-caju	44.7–74.86	22.90–29.36	32.16–56.00	2.07–2.55	7.10	6.65–8.05	Gupta et al., 2013; Patil, 2013
	Agaricus bisporus	47.1–51.0	21.3–27.0	38.3–48.9	2.53–3.92	17.7–23.3	7.77–11.0	Tsai et al., 2007
	Agrocybe cylindracea	61.40	1.50	89.60	0.30	40.4	8.60	Koutrotsios et al., 2014
	Hericium erinaceus	43.50	26.80	58.92	3.73	ND	10.55	Hassan, 2007
	Lentinula edodes	66.0–93.1	14.4–15.4	63.7–65.6	1.1–1.5	ND	3.8–4.4	Gaitán-Hernández & Norberto Cortés, 2014
	Pleurotus citrinopileatus	98.32	25.28	64.00	2.67	ND	8.05	Medany, 2014
	Pleurotus eryngii	48.29	21.10	56.10	2.40	13.35	7.62	Sardar et al., 2017
Rice straw	*Hericium erinaceus*	33.9	24.07	60.50	4.16	ND	11.27	Hassan, 2007
	Pleurotus sajor-caju	78.33	23.40	55.00	2.40	7.90	6.85	Patil, 2013
	Pleurotus citrinopileatus	77.52	22.84	64.93	3.17	ND	9.06	Medany, 2014
	Pleurotus eryngii	45.99	20.87	52.45	1.87	9.15	8.57	Sardar et al., 2017
	Lentinula edodes	48.68	16.30	78.22	5.80	ND	3.32	Gao et al., 2020
	Pleurotus ostreatus	10.67	14.85	47.87	6.33	12.39	18.56	Emiru et al., 2016
	Volvariella volvacea	11.75	13.12–20.00	ND	ND	ND	ND	Biswas & Layak, 2014
Sawdust	*Pleurotus ostreatus*	7.00–46.44	12.72–19.52	43.80–51.26	1.32–6.13	19.47–22.00	5.90–17.89	Hoa et al., 2015; Emiru et al., 2016
	Hericium erinaceus	50.30	24.83	60.95	3.59	ND	10.63	Hassan, 2007
	Pleurotus citrinopileatus	51.58	24.07	65.58	2.59	ND	7.76	Medany, 2014
	Pleurotus eryngii	35.47	18.93	52.53	2.42	6.78	7.51	Sardar et al., 2017
	Auricularia polytricha	44.63–99.49	10.22	78.45	0.85	ND	4.15	Liang et al., 2019
Beech sawdust	*Ganoderma lucidum*	61.24	16.84	77.86	2.21	47.93	3.10	Koutrotsios et al., 2019
	Agrocybe cylindracea	38.3	ND	ND	ND	ND	ND	Koutrotsios et al., 2014
	Pleurotus ostreatus	33.5	0.30	97.7	0.30	50.9	1.80	Koutrotsios et al., 2014
Eucalyptus sawdust	*Ganoderma lucidum*	0.30	9.6	ND	ND	41.2	1.10	de Carvalho et al., 2015
Sugarcane bagasse	*Pleurotus ostreatus*	65.65	27.13	34.94	1.32	22.00	6.68	Hoa et al., 2015
	Pleurotus eryngii	41.31	19.98	49.53	3.10	6.59	7.78	Sardar et al., 2017
	Lentinula edodes	130.2	13.80	73.0	1.0	ND	6.2	Salmones et al., 1999
Depithed bagasse	*Pleurotus ostreatus*	66.64	12.83	44.78	1.48	12.83	6.28	Aguilar-Rivera & De Jesús-Merales, 2010
Bagasse from mill	*Pleurotus ostreatus*	70.09	15.81	45.14	1.94	12.89	5.81	Aguilar-Rivera & De Jesús-Merales, 2010
Sugarcane leaves	*Lentinula edodes*	82.70	14.40	78.20	0.90	ND	6.50	Salmones et al., 1999
Cotton stalk	*Pleurotus ostreatus*	20.60	22.80	58.40	2.10	10.50	6.20	Sardar et al., 2020
	Pleurotus sajor-caju	41.42	31.40	42.70	0.95	ND	ND	Ragunathan & Swaminathan, 2003
Cotton waste	*Pleurotus eryngii*	71.56	25.36	59.69	5.18	9.10	8.12	Sardar et al., 2017
	Volvariella volvacea	ND	1.41–34.17	1.02	0.10	2.83–11.9	0.65–10.8	Ul Haq et al., 2011; Adedokun & Akuma, 2013
Cottonseed hull	*Pleurotus ostreatus*	8.97–61.00	14.27–17.5	49.54–65.9	1.2–6.10	10.2–26.53	3.56–5.2	Emiru et al., 2016; Sardar et al., 2020
Corncob	*Pleurotus ostreatus*	18.67–66.08	18.64–29.70	30.78–34.08	2.67–6.40	25.66–29.75	7.10–15.22	Hoa et al., 2015; Emiru et al., 2016
	Agrocybe cylindracea	46.80	2.70	93.30	0.60	35.9	3.40	Koutrotsios et al., 2014
	Pleurotus eryngii	51.80	23.72	54.69	1.88	9.68	6.97	Sardar et al., 2017
Soybean straw	*Pleurotus sajor-caju*	83.00	25.80	52.20	2.82	6.70	7.30	Patil, 2013
Jowar straw	*Pleurotus sajor-caju*	70.83	23.10	58.50	2.62	7.30	7.10	Patil, 2013
Coast-cross straw	*Agaricus bisporus*	44.1–58.3	29.80–37.88	ND	1.90–2.36	5.64–7.56	10.31–11.39	Andrade et al., 2008
Tifton straw	*Agaricus bisporus*	24.4–53.4	31.37–35.21	ND	2.05–2.34	6.07–7.60	10.60–11.77	Andrade et al., 2008
Oat straw	*Agaricus bisporus*	47.2–52.9	26.78–36.28	ND	2.34–3.06	6.57–10.31	9.83–11.36	Andrade et al., 2008
	Ganoderma lucidum	2.0	9.9	ND	ND	56.2	1.0	de Carvalho et al., 2015
Bean straw	*Ganoderma lucidum*	4.7	12.3	ND	ND	57.3	1.4	de Carvalho et al., 2015
Brachiaria grass straw	*Ganoderma lucidum*	3.50	11.60	ND	ND	48.80	1.3	de Carvalho et al., 2015

(*Continued*)

Table 3.1. Continued

Lignocellulosic substrate	Mushroom species	Biological efficiency (%)	Chemical composition (%, dry weight)					References
			Crude protein	Carbohydrate	Fat	Crude fiber	Ash	
Sunflower stalk	*Pleurotus sajor-caju*	63.13	21.00	50.70	2.75	7.65	6.90	Patil, 2013
Pigeaon stalk	*Pleurotus sajor-caju*	75.43	24.20	48.20	2.45	7.78	6.80	Patil, 2013
Oil palm whole stalk	*Volvariella volvacea*	5.46	29.67	49.26	3.52	8.46	9.09	Triyono et al., 2019
Sorghum stover	*Pleurotus sajor-caju*	36.84	36.2	43.2	1.41	ND	ND	Ragunathan & Swaminathan, 2003
Date palm tree leave	*Pleurotus ostreatus*	55.70	16.13	72.77	3.41	19.89	7.83	Koutrotsios et al., 2014
	Agrocybe cylindracea	52.4	6.20	82.8	0.10	32.9	10.9	Koutrotsios et al., 2014
Plantain leave	*Volvariella volvacea*	ND	1.01	1.37	0.10	2.77	0.95	Adedokun and Akuma, 2013
Cassava peels	*Pleurotus ostreatus*	26.00	10.48	73.07	2.18	8.88	7.69	Kortei et al., 2014
	Volvariella volvacea	1.47	14.24	51.42	2.44	0.4	6.16	Apetorgbor & Apetorgbor, 2015
Yam peel	*Volvariella volvacea*	4.49	14.63	50.31	2.23	0.59	3.85	Apetorgbor & Apetorgbor, 2015
Potato peel	*Volvariella volvacea*	1.05	14.49	48.32	2.31	0.56	6.84	Apetorgbor & Apetorgbor, 2015
Pine needles	*Pleurotus ostreatus*	24.74	22.74	75.88	2.44	13.68	7.50	Koutrotsios et al., 2014
	Agrocybe cylindracea	93.50	9.90	63.30	1.60	26.40	25.2	Koutrotsios et al., 2014
Oil palm stem	*Volvariella volvacea*	1.90	38.27	40.56	4.14	7.19	9.83	Triyono et al., 2019
Oil palm hump	*Volvariella volvacea*	3.48	32.47	47.15	3.45	7.57	9.35	Triyono et al., 2019
Tifton grass	*Ganoderma lucidum*	5.50	12.50	ND	ND	48.2	1.6	de Carvalho et al., 2015
Bracts of pineapple crown	*Lentinula edodes*	37.50	14.0	78.8	0.50	ND	6.7	Salmones et al., 1999
Extrated olive press cake	*Agrocybe cylindracea*	29.20	7.80	87.3	1.30	47.6	3.6	Koutrotsios et al., 2014
Coir fiber	*Pleurotus sajor-caju*	27.33	44.3	45.2	1.22	ND	ND	Ragunathan & Swaminathan, 2003

ND : Not Determined

Table 3.2 Biological Efficiency and chemical composition of some mushrooms cultivated on diverse LBR substrates in various combinations

Mushroom species	Lignocellulosic substrate	Biological efficiency (BE) (%)	Chemical Composition (%, Dry Weight)					Change in BE% (Compared with control)	Change in protein% (Compared with control)	References
			Crude protein	Carbohydrate	Fat	Crude Ffber	Ash			
Agrocybe cylindracea	Wheat straw + Raw two-phase olive mill waste (20%)	100.67	ND	ND	ND	ND	ND	45.53% ↑	ND	Zervakis et al., 2013
Auricularia polytricha	Sawdust + Panicum repens stalk (1:1 w/w)	124.70	10.37	78.49	0.87	ND	3.49	25.33% ↑	1.46% ↑	Liang et al., 2019
Auricularia polytricha	Sawdust + Pennisetum purpureum stalk (1:1 w/w)	129.54	9.13	79.65	0.74	ND	3.94	30.20% ↑	10.66% ↓	Liang et al., 2019
Auricularia polytricha	Sawdust + Zea mays stalk (1:1 w/w)	144.15	10.12	77.74	1.06	ND	4.35	44.88% ↑	0.97% ↓	Liang et al., 2019
Ganoderma lucidum	Beech sawdust + Olive pruning residues (1:1 w/w)	20.52	15.28	79.28	2.03	43.80	3.41	66.49% ↓	9.26% ↓	Koutrotsios et al., 2019
Ganoderma lucidum	Beech sawdust + Olive-mill wastes (1:1 w/w)	20.52	22.21	72.44	1.10	49.34	4.26	66.49% ↓	31.88% ↑	Koutrotsios et al., 2019
Lentinula edodes	Sawdust + Rice straw (80+20%)	36.09	15.80	78.22	5.75	ND	3.52	25.86% ↓	3.06% ↓	Gao et al., 2020
Pleurotus citrinopileatus	Rice straw + Wheat straw (1:1 w/w)	111.88	23.60	64.28	3.23	ND	8.89	44.22% ↑	3.32% ↑	Medany, 2014
Pleurotus citrinopileatus	Sawdust + Rice straw (1:1 w/w)	56.02	22.91	65.33	2.92	ND	8.84	8.60% ↑	4.81% ↑	Medany, 2014
Pleurotus citrinopileatus	Sawdust + Wheat straw (1:1 w/w)	51.83	26.01	63.77	2.54	ND	7.68	0.48% ↑	8.05% ↑	Medany, 2014
Pleurotus cystidiosus	Sawdust + Sugarcane bagasse (1:1 w/w)	44.11	18.66	46.86	3.28	24.5	6.70	21.61% ↑	10.00% ↑	Hoa et al., 2015
Pleurotus cystidiosus	Sawdust + Corncob (1:1 w/w)	43.57	21.47	44.85	2.50	23.58	7.30	20.12% ↑	36.92% ↑	Hoa et al., 2015
Pleurotus eryngii	Wheat straw + Raw two-phase olive mill waste (20%)	96.12	ND	ND	ND	ND	ND	9.82% ↑	ND	Zervakis et al., 2013

(*Continued*)

Mushroom species	Lignocellulosic substrate	Biological efficiency (BE) (%)	Chemical Composition (%, Dry Weight)					Change in BE% (Compared with control)	Change in protein% (Compared with control)	References
			Crude protein	Carbohydrate	Fat	Crude Ffber	Ash			
Pleurotus eryngii	Wheat straw + Grape Marc (1:1 w/w)	87.24	ND	ND	ND	ND	ND	52.17% ↑	ND	Koutrotsios et al., 2018
Pleurotus ostreatus	Saw dust + Rice straw (1:1 w/w)	13.67	15.29	41.96	5.40	27.01	10.33	95.28% ↑	20.20% ↑	Emiru et al., 2016
Pleurotus ostreatus	Saw dust + Cottonseed hull (1:1 w/w)	27.00	15.00	42.08	3.50	30.59	8.83	285% ↑	17.92% ↑	Emiru et al., 2016
Pleurotus ostreatus	Saw dust + Maize cob (1:1 w/w)	8.67	17.04	29.96	8.40	32.60	12.00	23.85% ↑	33.96% ↑	Emiru et al., 2016
Pleurotus ostreatus	Rice straw + Cottonseed hull (1:1 w/w)	6.00	14.12	51.44	4.00	27.10	3.33	40% ↓	4.91% ↓	Emiru et al., 2016
Pleurotus ostreatus	Rice straw + Maize cob (1:1 w/w)	8.33	15.43	43.75	4.35	23.80	12.67	16.7% ↓	3.90% ↑	Emiru et al., 2016
Pleurotus ostreatus	Cottonseed hull + Maize cob (1:1 w/w)	33.33	16.31	48.16	5.50	24.70	5.33	185.60% ↑	14.29% ↑	Emiru et al., 2016
Pleurotus ostreatus	Paddy straw + Soybean straw (1:1 w/w)	81.69	23.00	50.50	2.70	7.68	6.42	3.39% ↓	1.70% ↓	Patil et al., 2010
Pleurotus ostreatus	Wheat straw + Soybean straw (1:1 w/w)	77.66	21.10	52.00	2.56	7.40	6.15	7.77% ↑	4.76% ↑	Patil et al., 2010
Pleurotus ostreatus	Wheat straw + Paddy straw (1:1 w/w)	71.76	20.33	56.20	2.58	7.50	5.90	0.41% ↓	3.19% ↓	Patil et al., 2010
Pleurotus ostreatus	Cotton stalk + Cottonseed hell (1:1 w/w)	20.2	22.8	58.0	2.9	10.8	5.5	1.94% ↓	0%	Sardar et al., 2020
Pleurotus ostreatus	Wheat straw + Olive pruning residues (1:1 w/w)	56.79	19.88	71.76	1.87	16.54	6.49	26.49% ↓	30.61% ↑	Koutrotsios et al., 2019
Pleurotus ostreatus	Wheat straw + Olive-mill wastes (1:1 w/w)	71.33	19.32	68.56	2.70	12.97	9.42	7.67% ↓	26.93% ↑	Koutrotsios et al., 2019

ND: Not Determined; ↑: Increase; ↓: Decrease

Figure 3. Classification and mechanism of action of mushroom lignocellulolytic enzymes

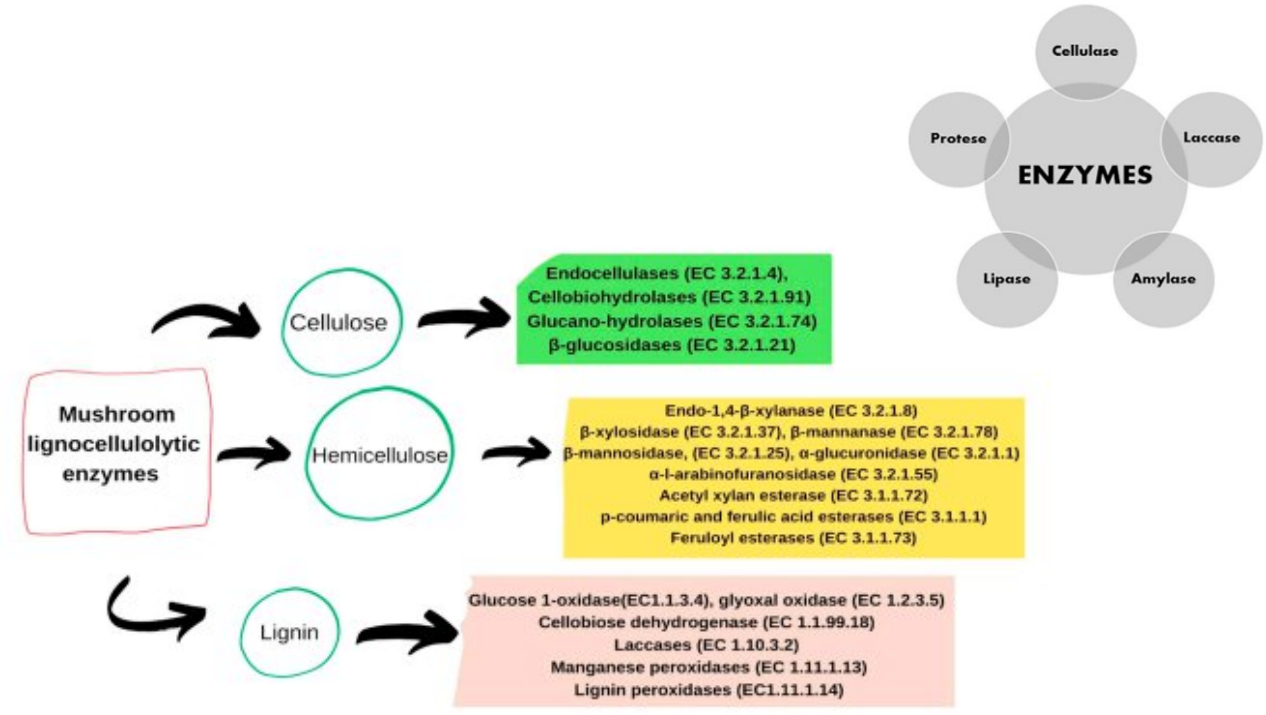


Figure 4. Possible uses of wild edible fruitbodies[3]

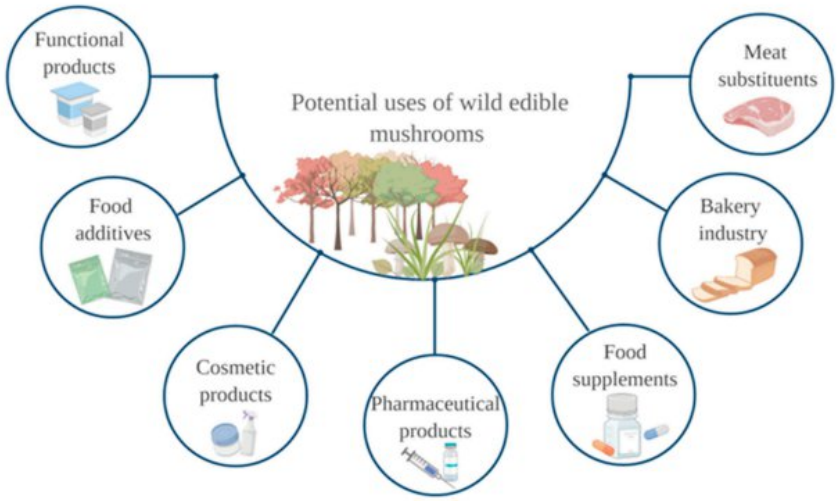
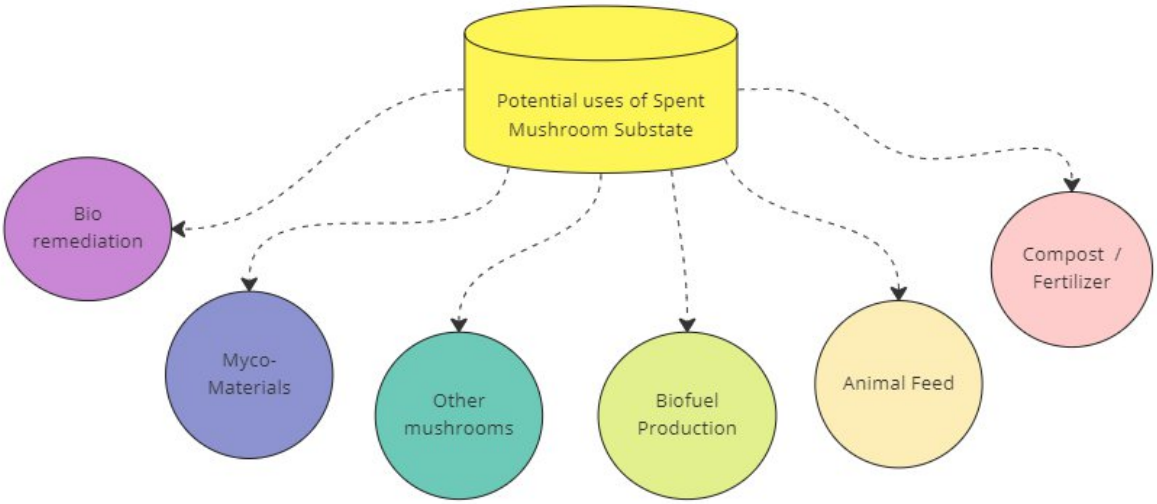


Figure 5. Possible uses of spent-mushroom-substrate



[3] Dhull (2022)