PANGAN FUNGSIONAL UNTUK PENCEGAHAN PENYAKIT KRONIS

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HUBUNGAN HAM DENGAN FOOD SECURITY (KETAHANAN PANGAN)

1974

At the 1974 World Food Conference, governments examined the global problem of food production and consumption, and solemnly proclaimed that "every man, woman and child has the inalienable right to be free from hunger and malnutrition in order to develop their physical and mental faculties"

1974, **1986**

- World Bank (1986) defined food security as "access by all people at all times to enough food for an active and healthy life"

Action:

- Food production and availability
- Food distribution and accessibility by all
- Individual consumption and meeting nutritional needs
- Food insecurity monitor

Food insecurity: unsafe food?

In the United States, each year one in four citizens suffers from a **food borne illness**. This translates to 76 million people.

In 1993, **food poisoning** outbreak in Denmark affected 700 people who had eaten pork contaminated with *Salmonella*

Present findings that **cancer causing agents** may be found in our everyday food. So what is safe?

Rome Declaration at World Food Summit
Nov 13, 1996

The Declaration enunciates both the ultimate goal and the immediate target: *"We pledge our political will and our common and national commitment to achieving food security for all and to an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level by 2015."*

1974, 1986, **1996**

Rome Declaration at World Food Summit on 13 November 1996

" … the right of everyone to have access to **safe** and nutritious food, consistent with the right to **adequate food** and the fundamental right of everyone to be free from hunger."

Declaration touches on two issues

food security
food safety

BELUM: DEGENERATIF/KRONIS
RESMI 2013: GULA,/KARBOHIDRAT MURNI

http://www.fao.org/wfs/final/rd-e.htm

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FOOD PRODUCTION AND AVAILABILITY : lokal atau impor?

FOOD DISTRIBUTION AND ACCESSIBILITY BY ALL

INDIVIDUAL CONSUMPTION AND MEETING NUTRITIONAL/ FUNCTIONAL NEEDS

KEBIJAKAN PANGAN DI INDONESIA= KETAHANAN PANGAN?

FOOD PRODUCTION AND AVAILABILITY Produksi lokal atau impor?

	IMPOR	LOKAL
WAKTU	SINGKAT	LAMA
KEMUDAHAN	MUDAH	- LEBIH SULIT
KEMANDIRIAN /SECURITY/KEAMANAN	TIDAK ADA	PASTI MANDIRI: POTENSI BESAR
MODAL	BANYAK	LEBIH BANYAK
DISTRIBUSI	LUAS	TERBATAS
KEMAPANAN (SUSTAINABILITY)	TIDAK	PASTI: POTENSI HRS DIREALISASIKAN

FOOD DISTRIBUTION AND ACCESSIBILITY BY ALL: PRODUKSI LOKAL

IMPOR UNTUK SATU MUSIM SAJA,
PERLU SIAPKAN MODAL UNTUK BIAYA IMPOR DAN BIAYA AGRIKULTUR (AMAT LAYAK)
SETELAH SATU MUSIM SUDAH BISA PANEN, TIDAK PERLI IMPOR LAGI

INDIVIDUAL CONSUMPTION AND MEETING NUTRITIONAL/ FUNCTIONAL NEEDS: 250.000.000 ORANG TERSEBAR DI SELURUH ARCHIPELAGO

PRODUKSI LOKAL MENCIPTAKAN PASAR RAKYAT EKONOMI RAKYAT KECIL

SUMBER KARBOHIDRAT

SUMBER PROTEIN

SUMBER VITAMIN MINERAL SERAT KOMPONEN BIOAKTIF/ANTIOKSIDAN RASA

PANGAN FUNGSIONAL: BAHAN PANGAN UNTUK POLA MAKAN SEHAT YG DAPAT MENCEGAH PENYAKIT DEGENERATIF DAN GIZI KURANG

BAHAN POLA MAKAN SEHAT

WHO 2012:

SUMBER YANG PALING KREDIBEL

- NABATI
- UTUH (BERAS COKLAT BUKAN BERAS PUTIH, BUKAN TERIGU)
- ALAMI (BUKAN SENYAWA KIMIA SINTETIK)

MAKANAN dapat Memicu /mencegah KANKER:

-salah satu penyakit kronis

-WHO: second to death

-Jika dapat mencegah kanker, mencegah penyakit kronis lainnya

Food, Nutrition and the Prevention of Cancer

a global perspective

SUMMARY

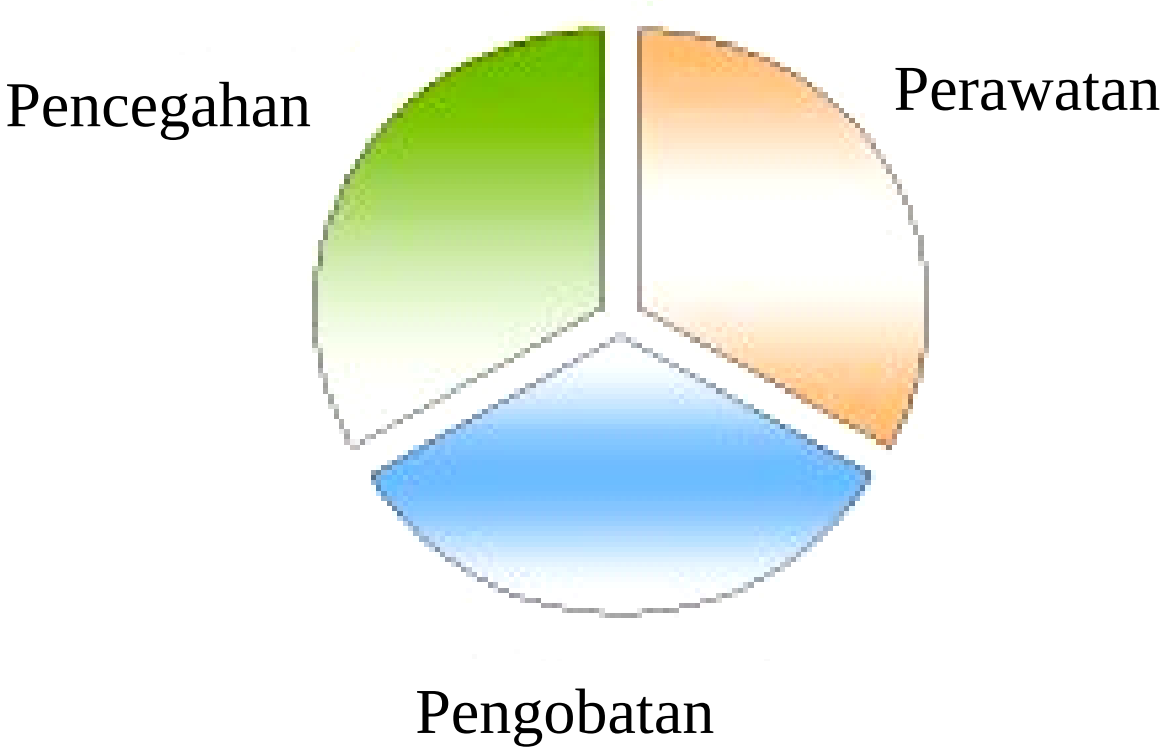
It is abundantly clear that the incidence of all the common cancers in human is being determined by various potentially controllable external factors.

This is surely the most comforting fact to come out of all cancer research, for it means that cancer is, in large part, a preventable diseases.

World Cancer Research Funds (WCRF) & American Institute for Cancer Research (AICR) 1997: 670 halaman

WHO 2002

CANCER STRATEGIES



Bagaimana terjadinya kanker ?

85% kejadian kanker disebabkan oleh faktor
dari luar tubuh:
Karsinogen (Polusi makanan /Minuman/ udara/air), sinar UV, virus, infeksi

Hanya **15%** disebabkan oleh keturunan

Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective

Second Expert Report* – *Expert Panel Chair

Professor Sir Michael Marmot
University College London

SEPULUH TAHUN KEMUDIAN (DEKADE KE 2)

World Cancer Research Fund

American Institute for Cancer Research

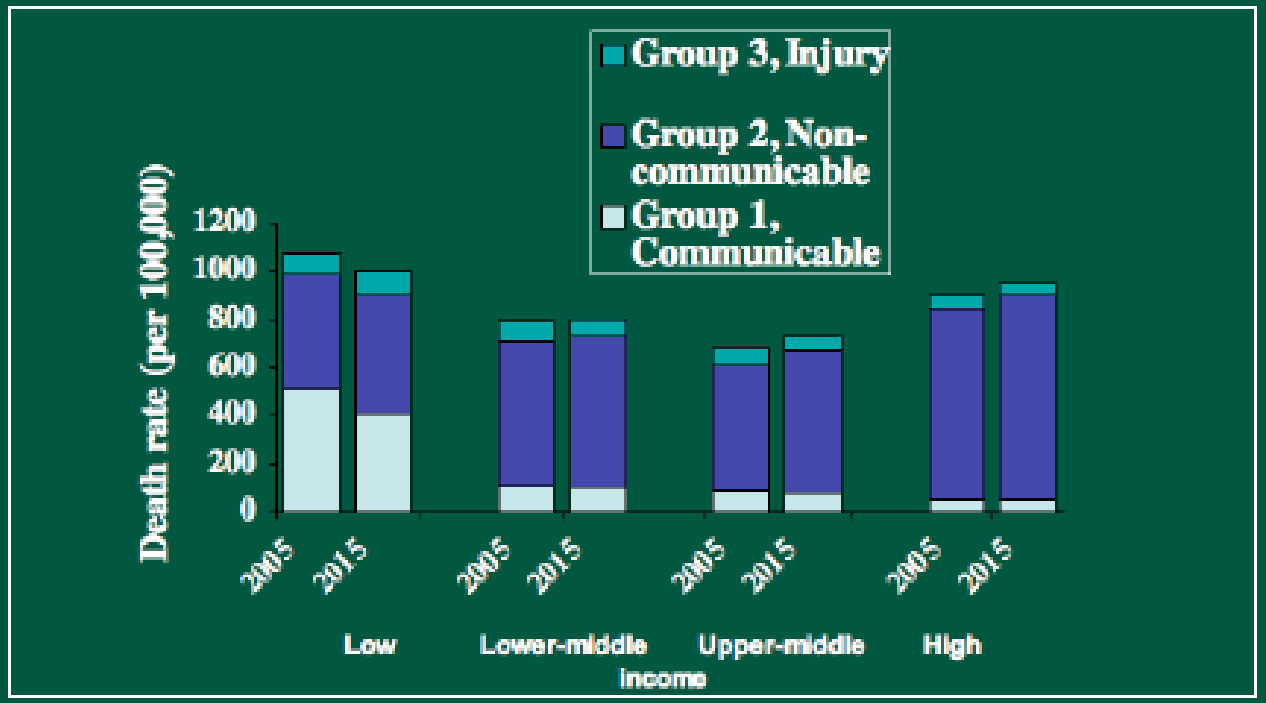
CONFERENCE HONGKONG DECEMBER 2007

Scale of the project

1. 5 years
2. Meeting every 6 months
3. Initially identified 500,000 papers

- > 6000 considered
- 20 Systematic Literature Review groups

Global Pattern of Disease

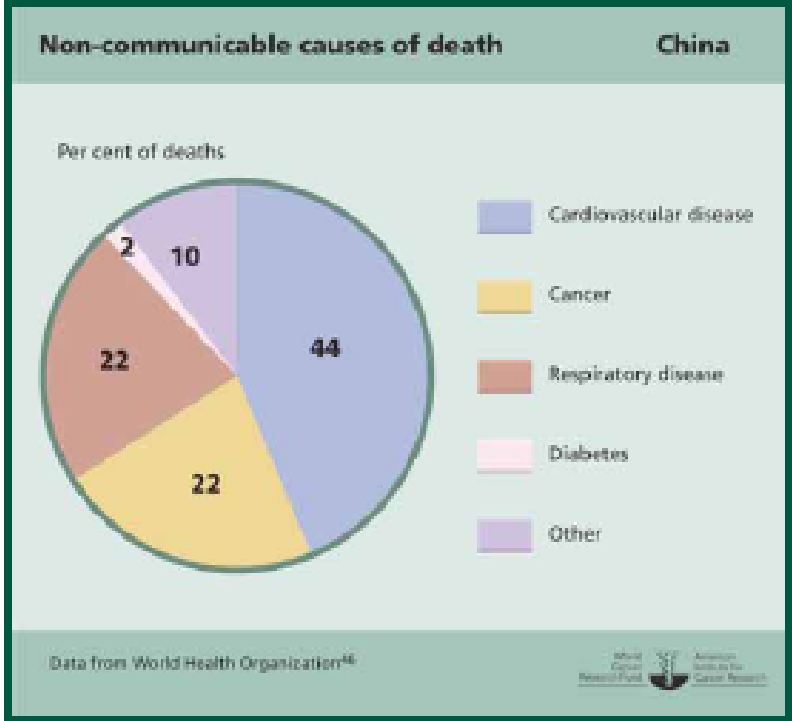


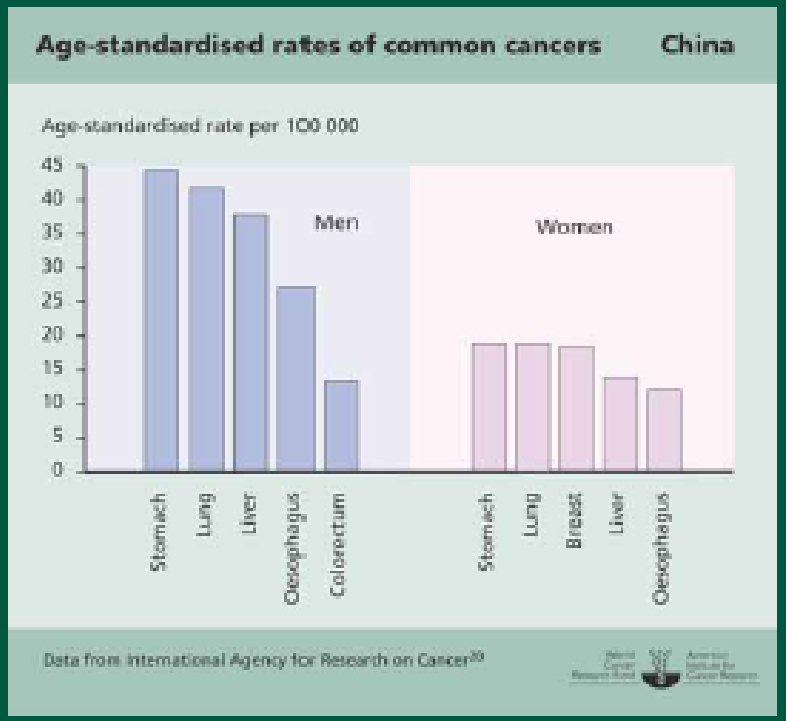
Countries grouped by income

(WHO 2005)

World Cancer Research Fund | American Institute for Cancer Research

Global Patterns in Cancer: China



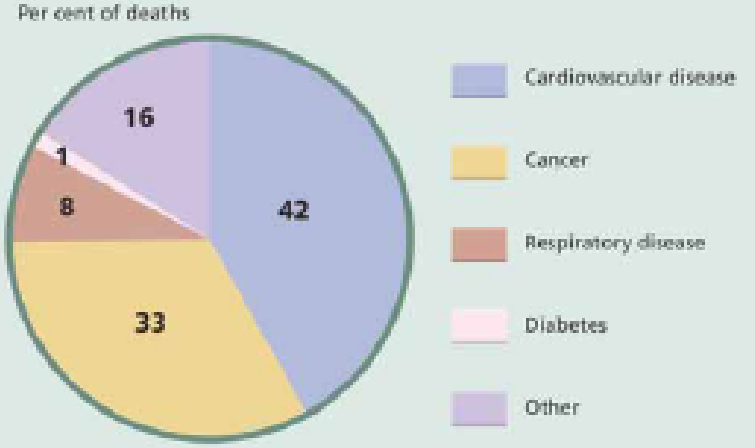


World Cancer Research Fund

American Institute for Cancer Research

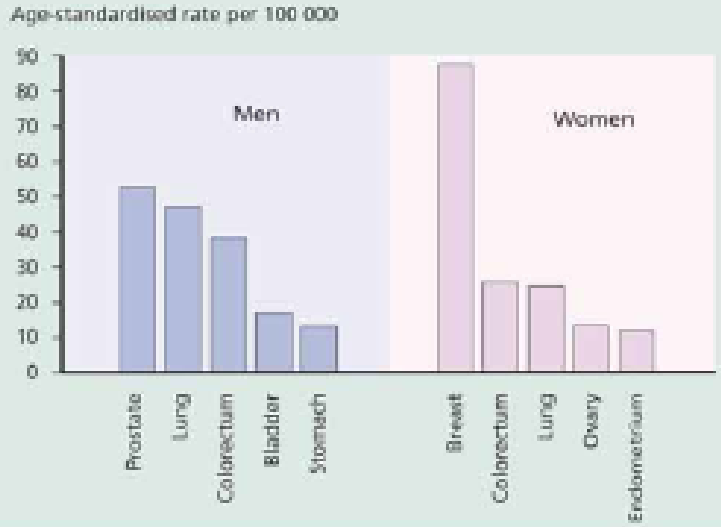
Global Patterns in Cancer: UK

Non-communicable causes of death **UK**



Data from World Health Organization[6]

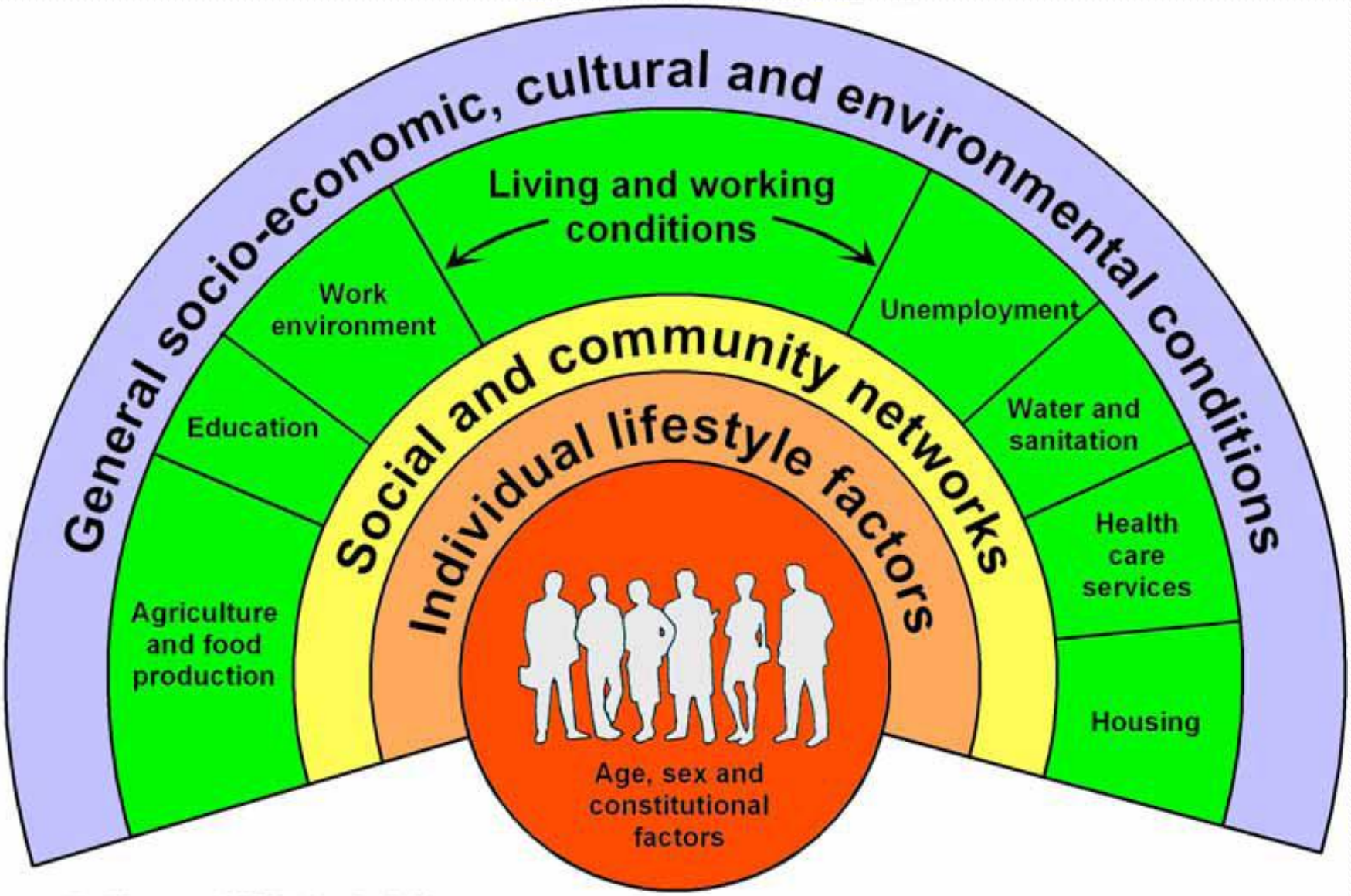
Age-standardised rates of common cancers **UK**



Data from International Agency for Research on Cancer[19]

World Cancer Research Fund | American Institute for Cancer Research

The main determinants of health



Source: Dahlgren and Whitehead, 1991

Recommendations

1. For ‘convincing’ or ‘probable’ exposures only
2. Consistent with recommendations for other chronic diseases

Recommendations cover

1. Body fatness and physical activity
2. Diet
   - Foods and drinks that promote weight gain
   - Plant foods
   - Animal foods
   - Alcoholic drinks
   - Preservation, processing, preparation
   - Dietary supplements
3. Special recommendations
   - Breastfeeding
   - Cancer survivors

World Cancer Research Fund | American Institute for Cancer Research

RECOMMENDATION 4

PLANT FOODS

Eat mostly foods of plant origin

PUBLIC HEALTH GOALS

Population average consumption of non-starchy[1] vegetables and of fruits to be at least 600 g (21 oz) daily[2]

Relatively unprocessed cereals (grains) and/or pulses (legumes), and other foods that are a natural source of dietary fibre, to contribute to a population average of at least 25 g non-starch polysaccharide daily

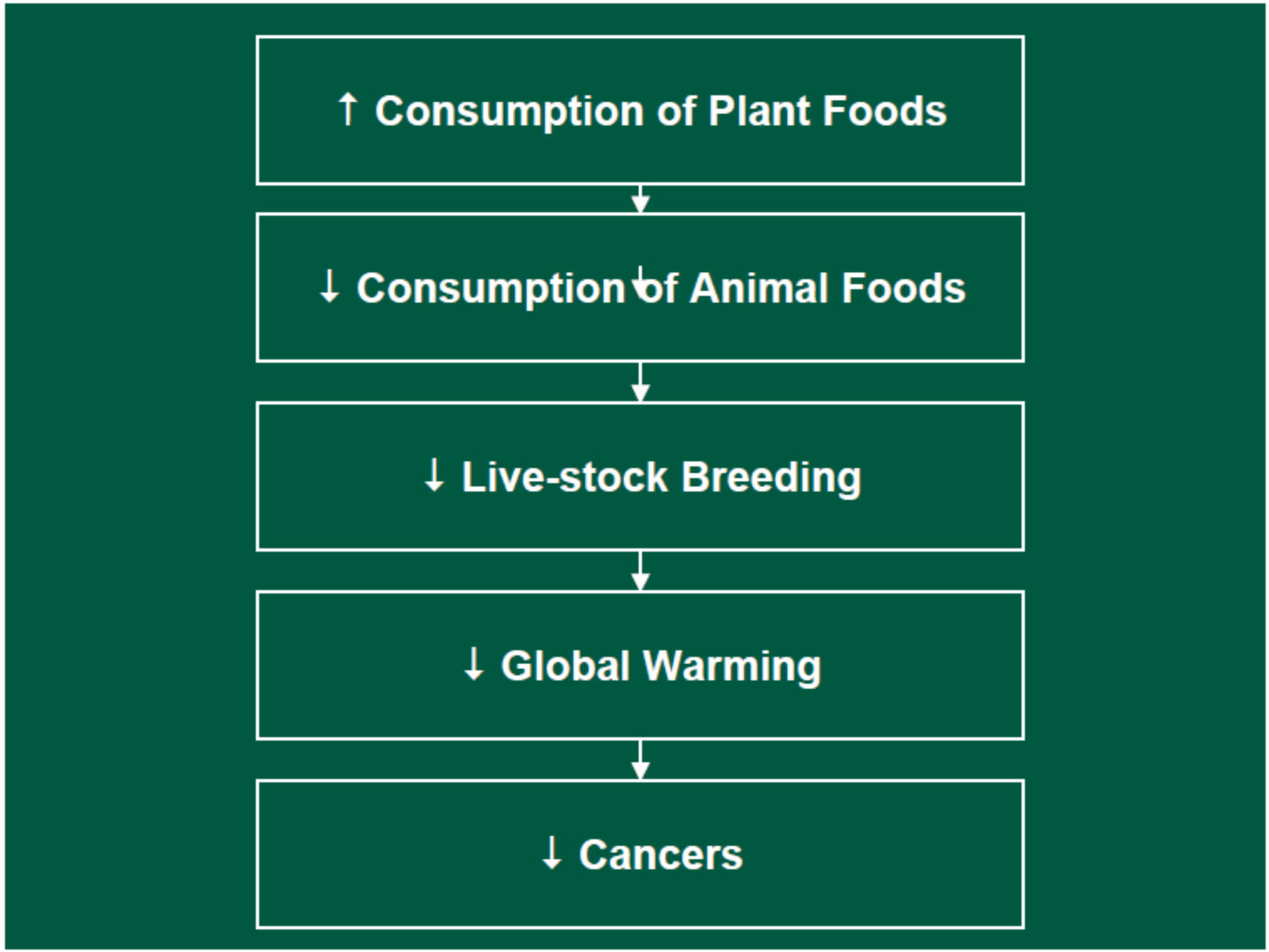
PERSONAL RECOMMENDATIONS

Eat at least five portions/servings (at least 400 g or 14 oz) of a variety[2] of non-starchy vegetables and of fruits every day

Eat relatively unprocessed cereals (grains) and/or pulses (legumes) with every meal[3]

Limit refined starchy foods

The recommendation is in consonance with the theme of the 2007 NOBEL PRIZE for peace.


↑ Consumption of Plant Foods
↓ Consumption of Animal Foods
↓ Live-stock Breeding
↓ Global Warming
↓ Cancers

RECOMMENDATION 7

PRESERVATION, PROCESSING, PREPARATION

Limit consumption of salt[1]
Avoid mouldy cereals (grains) or pulses (legumes)

PUBLIC HEALTH GOALS

Population average consumption of salt from all sources to be less than 5 g (2 g of sodium) a day

Proportion of the population consuming more than 6 g of salt (2.4 g of sodium) a day to be halved every 10 years

Minimise exposure to aflatoxins from mouldy cereals (grains) or pulses (legumes)

PERSONAL RECOMMENDATIONS

Avoid salt-preserved, salted, or salty foods; preserve foods without using salt[1]

Limit consumption of processed foods with added salt to ensure an intake of less than 6 g (2.4 g sodium) a day

Do not eat mouldy cereals (grains) or pulses (legumes)

[1] Methods of preservation that do not or need not use salt include refrigeration, freezing, drying, bottling, canning, and fermentation

RECOMMENDATION 8

Aim to meet nutritional needs through diet alone

PUBLIC HEALTH GOALS

Maximise the proportion of the population achieving nutritional adequacy without dietary supplements

PERSONAL RECOMMENDATION

Dietary supplements are not recommended for cancer prevention

World Cancer Research Fund

American Institute for Cancer Research

MAKAN IKAN DAN NASI SAMA BANYAKNYA: BAGUS
KURANG: SAYURAN DAN BUAH, BERAS COKLAT

Aplikasi sorgum sebagai pangan sehat untuk penderita dan mencegah Diabetes dan kanker

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2014

HALF POLISHED SORGHUM HAS LOWER LOW GLYCEMIC INDEX AND HIGHER ANTIOXIDANT ACTIVITY ON ERYTHOCYTE AND PREVENTED COLON CANCER DEVELOPMENT IN RATS INDUCED WITH AOM CARCINOGEN

SORGUM SETENGAH SOSOH.
ANTI DIABETES, ANTI KANKER

FRANSISKA RUNGKAT-ZAKARIA[1], YUSDA SALIMI[2] AND BAMBANG PONCO[3]

BACKGROUND

- Consumption of food derived from plants is expected to increase a long with the awareness of health maintenance (KONSUMSI PANGAN NABATI AKAN MENINGKAT)
- Increasing demand of whole unpolished grains is predicted to rise due to interest in this grains as sources of complex carbohydrate and bioactive compounds such as antioxidants (BIJI UTUH, TIDAK DISOSOH)
- This prediction is related to the recommendation by WHO (1997, 2008) on diet for the prevention of cancer and other degenerative diseases

WHO 2008

DIABETES: 90 % KARENA POLA MAKAN DAN AKTIFITAS FISIK KURANG

PENYAKIT JANTUNG: 80 %.....

KANKER: 35%.....

POLA MAKAN SEHAT YG DISARANKAN:....

NABATI (TANAMAN).....

UTUH (DIKUNYAH).....

ALAMI .....

VARIASI.....

DIABETES:
GULA DARAH TIDAK TERKONTROL/TINGGI
PANKREAS (PENGHASIL INSULIN): RUSAK
TEKANAN OKSIDATIF
(BANYAK SENYAWA RADIKAL/RADIKAL BEBAS)

NEED: FOODS WITH

- LOW GLYCEMIC INDEX:

  WHOLE FOODS AS SOURCE
  OF COMPLEX CARBOHYDRATE

- FOODS WITH HIGH ANTIOXIDANTS

- TINGGI SERAT

Sorghum (*Sorghum bicolor* L Moench)

- Important grain originated from Africa
- Spread and produced in countries
- World production in 1990: 58 million tons

  USA: Amerika (25 persen), India (21 .5 psersen), Mexico (11 persen), Cina (9 persen) , Nigeria (7 persen).
- Consumed by 500 millions people in > 30 countries

  In form of unleavened bread (capati) and porridge (FAO, 1991).
- Indonesia has developed several varieties (UPCA-S1, UPCA-S2, No.46, No.6c , No. 7c)
- but yet consumed regularly

Sebaran Komoditi

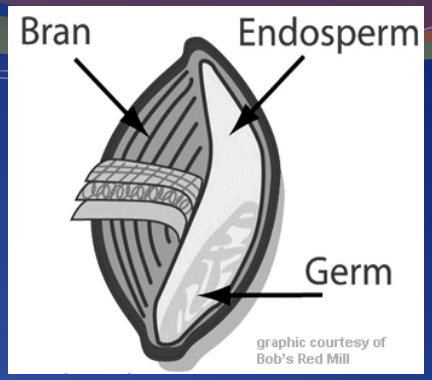
Anonymous (2006)

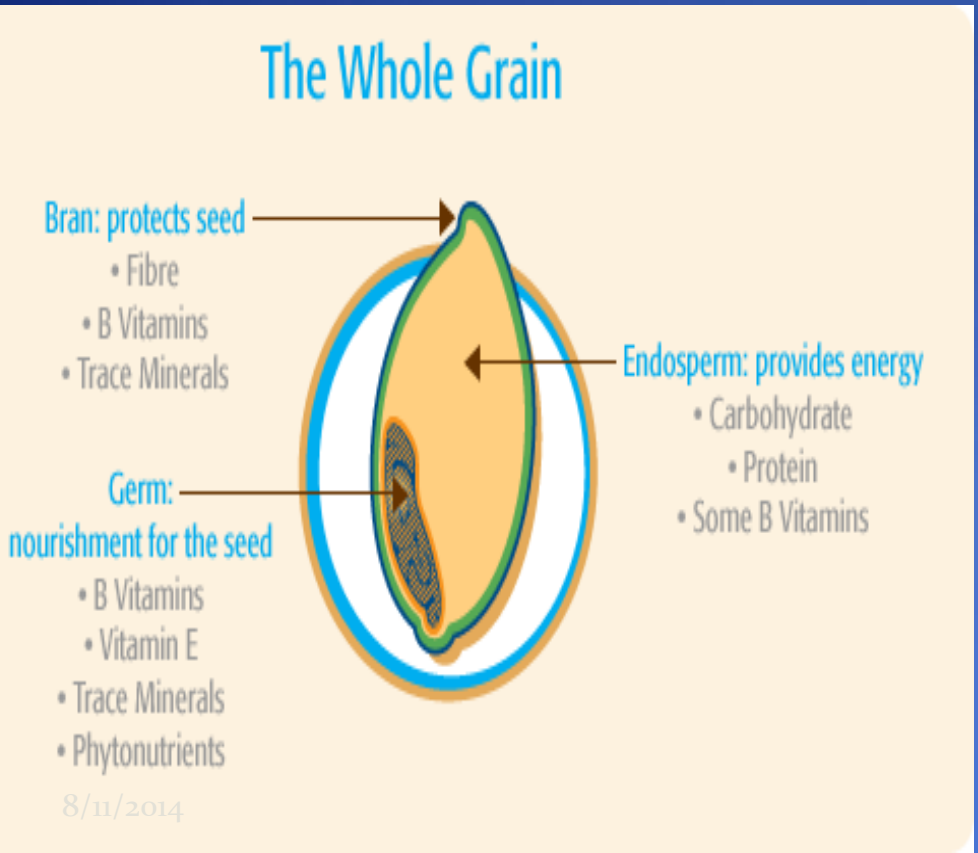
Indonesia → ancaman krisis pangan pd 2035. Jmlh penduduk 400 juta → kebutuhan beras nasional mencapai ±36 juta ton.

Produksi beras nasional masih di kisaran 25 - 29 juta ton → Defisit Pangan Nasional

Sumber karbohidrat utama penduduk Indonesia → padi & jagung → Produksi kedua komoditi belum mencukupi kebutuhan pangan nasional → impor kedua komoditi masih tinggi

Gambar Struktur Biji Sorgum





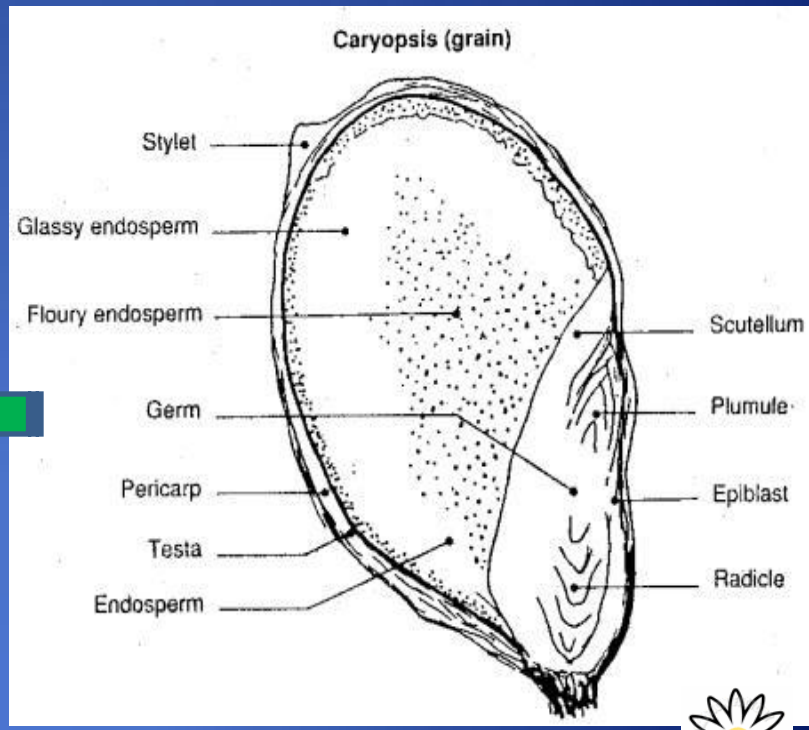


Table 1 Komposisi gizi sorgum dan bahan pangan sumber karbohidrat per 100 gram bahan

Bahan pangan	Kalori (Kal)	Protein (g)	Lemak (g)	Karbohidrat (g)	Air (%)	Serat (%)	P (mg)	Ca (mg)	Fe (mg)
Sorgum	332	11	3.3	73	11.2	2.3	28	287	4.4
Beras	360	7	0.7	79	9.8	1	6	147	0.8
Jagung	361	9	4.5	72	13.5	2.7	9	380	4.6
Kentang	83	2	0.1	19	-	-	11	56	0.7
Ubi kayu	157	1.2	0.3	35	63	-	33	40	0.7
Ubi jalar	123	1.8	0.7	28	-	-	30	49	0.7
Terigu	365	8.9	1.3	7.7	-	-	16	106	1.2

Table 2
Dietary fibers composition (% dry basis) of wheat flours and whole grain cereals

Cereal	Soluble dietary fiber	Resistant starch	Insoluble dietary fiber	Total dietary fiber
Hard wheat	1.61 ± 0.01	0.20 ± 0.02	2.98 ± 0.01	4.59 ± 0.21
Soft wheat	1.78 ± 0.01	0.55 ± 0.01	1.87 ± 0.01	3.65 ± 0.11
Barley	2.56 ± 0.03	0.23 ± 0.01	22.07 ± 0.41	24.63 ± 0.52
Millet	1.45 ± 0.01	1.96 ± 0.01	13.50 ± 0.32	14.95 ± 0.41
Rye	3.70 ± 0.02	0.20 ± 0.01	14.07 ± 0.23	17.77 ± 0.53
Sorghum	1.42 ± 0.01	1.77 ± 0.02	19.59 ± 0.41	21.01 ± 0.41

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Tabel 3 Komponen fenolik sorgum

Komponen Fenolik	Jumlah (mg/g bk)	Referensi
Asam hidroksibenzoat		
ρ-Hiroksibenzoat	15 - 36	Han *et al*. 1983
Gallat	26 -46	Han *et al*. 1983
Protokatekin	24-141	Han *et al*. 1983
Vanilin	8- 50	Han *et al*. 1983
Asam hidroksisinamat		
ρ-Kaumarat	100-200	Verbruggen *et al*. 1993
Kafeat	25- 52	Han *et al*. 1983
Ferulat	300-500	Verbruggen *et al*. 1993
Sinapat	50-140	Han *et al*. 1983
Flavonoid		
Antosianin	0-2800	Sereme *et al*. 1992; Awika *et al*. 2003,2004b
3-deoksiantosianidin (epigenidin, luteolinidin,sianidin, malvidin delpinidin)	0-4000	Dicko *et al* 2005
Flavan-4-ol	0-1300	Bate-Smith 1969; Audilakshmi *et al* 1999; Dicko *et al*. 2005
Proantosianidin (Flavan-3-ol, katekin, epikatekin, prosianidin)	0-68000	Beta *et al*. 1999; Awika & Rooney 1004; Dicko *et al*. 2005

Sumber Awika & Rooney 2004; Dicko *et al*. 2006

Table 3
Contents of the major phenolic acids in cereals

Phenolic acid	Cereal	µg/g (dry wt)[a]	Reference
Grain			
Ferulic (**18**)	Sorghum	100–500	Hahn and Rooney (1986); Hahn (1984)
	Corn	1740	Adom and Liu (2002)
	Rye	900–1170	Adom and Liu (2002)
	Wheat	640	Adom and Liu (2002)
	Oats	360	Adom and Liu (2002)
	Rice	300	Andreasen et al. (2000)
	Barley	225[b]	Maillard and Berset (1995)
Sinapic (**21**)	Sorghum	50–140	Hahn et al. (1983)
	Rye	70–140	Andreasen et al. (2000)
p-Coumaric (**20**)	Sorghum	70–230	Hahn et al. (1983)
	Rye	40–70	Andreasen et al. (2000)
	Barley	80[b]	Maillard and Berset (1995)
Bran			
Ferulic (**18**)	Sorghum bran	1400–2170	Hahn (1984)
	Wheat bran	5410	Andreasen et al. (2001a)
	Rye bran	2780	Andreasen et al. (2001a)
Sinapic (**21**)	Sorghum bran	100–630	Hahn (1984)
	Wheat bran	75	Andreasen et al. (2001a)
	Rye bran	390	Andreasen et al. (2001a)
p-Coumaric (**20**)	Sorghum bran	0–970	Hahn (1984)
	Wheat bran	170	Andreasen et al. (2001a)
	Rye bran	190	Andreasen et al. (2001a)

[a] Total (free and bound) measured by HPLC.
[b] Bound only.

Table 7
Antioxidant (ORAC) activity in sorghum brans relative to common fruits

Sample	ORAC[a] (dry wt)	Reference
Black sorghum bran	1010	Awika (2003)
Brown sorghum bran	2400–3100	Awika (2003)
Blueberries	87–870	Moyer et al. (2002)
Strawberries	356–400	Wu et al. (2002)[b]
Plums	452–600	Wu et al. (2002)
Grapes	100	Wu et al. (2002)
Watermelon	15	Wu et al. (2002)
Orange	80–150	Wu et al. (2002)

[a] μmol TE/g, using fluorescein as a probe.
[b] Unpublished data, courtesy of Wu, X., Arkansas Children's Nutrition Center, USDA-ARS, AR.

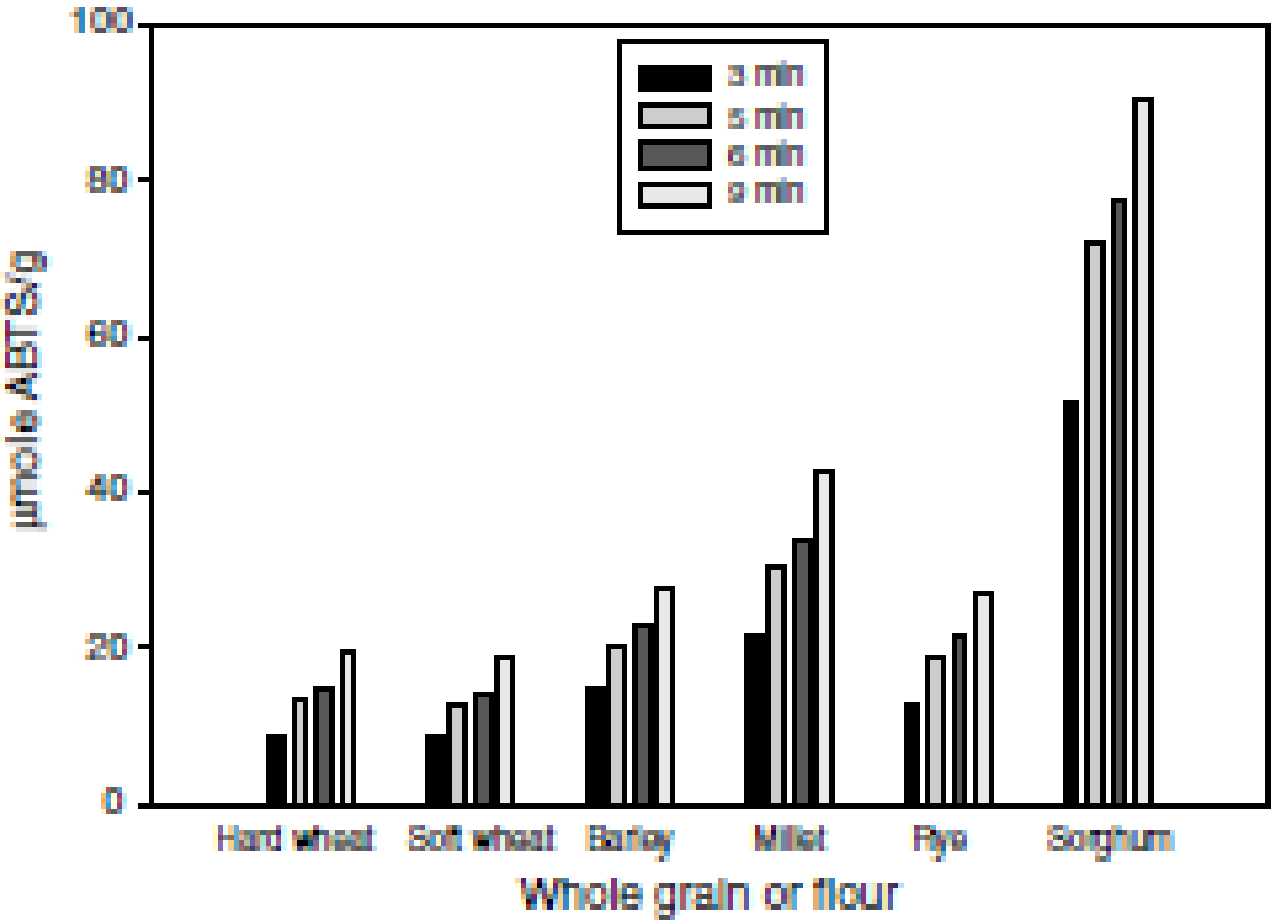

Fig. 2. Radical cation ABTS scavenging capacity of wheat flour and cereal whole grain extracts at different time.

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policosanols

- Approximately 38–92 mg / 100 g sorghum grain.
- Weller and Hwang (2003) reported that these compounds may be the most commercially valuable.
- Castano et al. (2002): 10 mg/day of policosanol was more effective than 20 mg/day of lovastatinin reducing LDL cholesterol and raising HDL cholesterol levels.
- These authors also report that the policosanols present no toxic effects even at high doses.
- Other positive benefits: lipid peroxidation, platelet aggregation and smooth muscle cell proliferation
- natural, safe and effective dietary alternatives to statin medication.
- Efficacy and economic potential of the sorghum policosanols should be investigated.

- sorgum kaya selulosa, β-glukan, hemiselulosa (Waniska 2000) PD BEKATULNYA.
- Banyak memiliki peranan untuk pencegahan penyakit degeneratif seperti diabetes millitus dan kanker.

Polifenol
&
Flavonoid
Lipid
serat

Efek kesehatan

Serealia

- Menekan kolesterol
- Melindungi lipid dari oksidasi
- Antikarsinogenik
- Menghambat pertumbuhan tumor & kanker
- Meningkatkan sistem imun
- Melindungi sel eritrosit dari hemolisis
- Mengurangi penyakit-penyakit karena oksidasi *low density lipoprotein* (LDL)
- Baik untuk diabetisi dan orang sehat

Komponen serat dan antioksidan serealia → "oatmeal"

Dikomersialisasikan secara besar-besaran di dunia.

Berperan sebagai :

- **Imunomodulator**
- **Anti aterosklerosis**

Sebagai makanan langsung atau raw material untuk produk lain

Deskripsi konsumen :
(+) Produk secara keseluruhan menyenangkan & memiliki efek baik bagi kesehatan
(-) Harga cukup mahal.....
Sumber : www.quakeroatmeal.com

PEMANFAATAN SORGUM

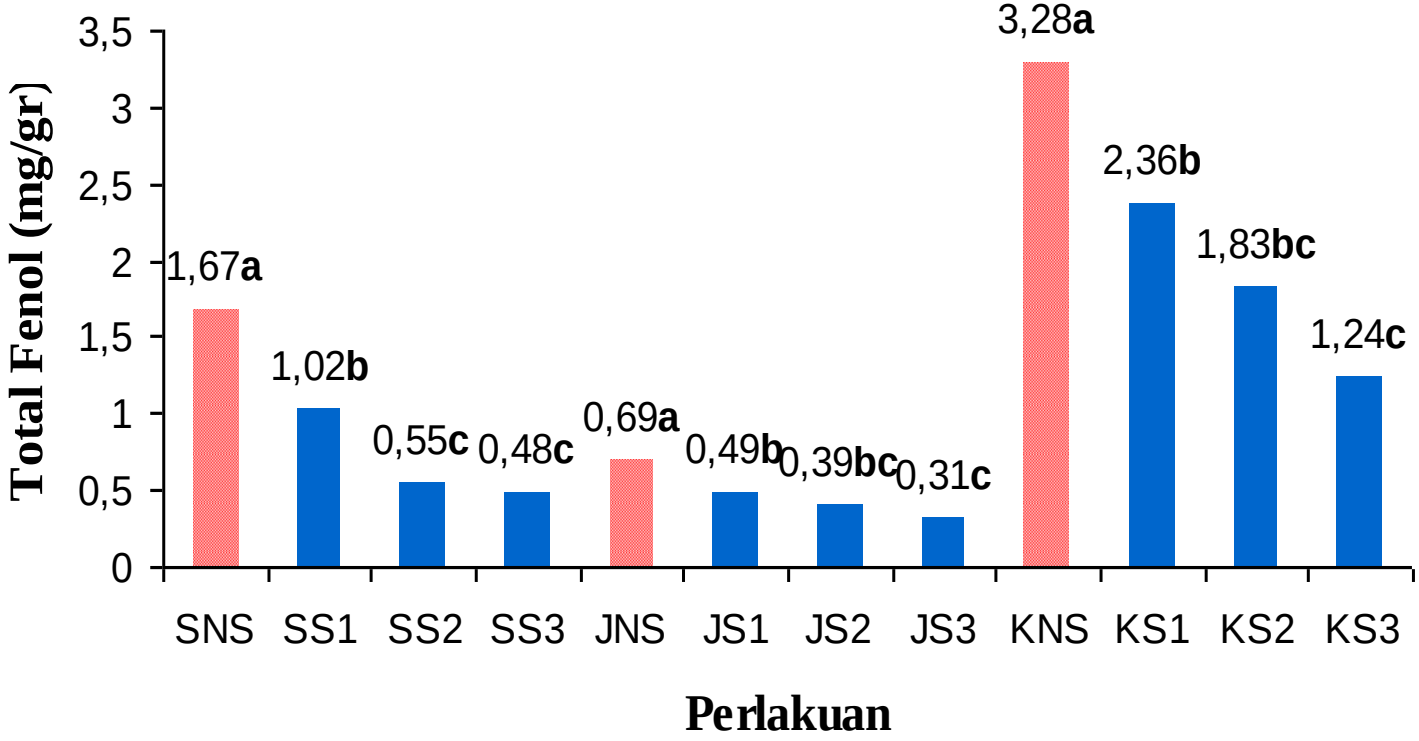
1. Konsumsi beras dapat diturunkan tetapi tidak menganggu konsumsi kalori
2. Pangan untuk penderita diabetes, mencegah diabetes
3. Menyiapkan bahan baku untuk implementasi program diversifikasi pangan, khususnya diversifikasi karbohidrat
4. Meningkatkan kegiatan budidaya serealia lain selain beras
5. Mempertahankan keragaman hayati serealia tropikal di Indonesia

Uji Pasca Penyosohan

Analisa Proksimat

Tabel 1. Hasil analisa proksimat Sorgum, Jewawut dan Ketan hitam sebelum dan sesudah disosoh

Komposisi kimia	Nilai Rerata (%)											
	Sorgum				Jewawut				Ketan Hitam			
	0’	20’	60’	100’	0’	100’	200’	300’	0’	5’	15’	25’
Kadar air	11,4223	10,3386	8,6175	7,3112	8,5929	7,6094	5,9334	5,1170	13,1402	12,5278	10,6991	8,1416
Kadar abu	1,7736	1,4947	1,1683	0,9674	3,0174	1,7682	1,0682	0,9492	1,7709	1,5135	1,0269	0,9198
Protein	6,5455	6,2313	5,9105	5,3930	7,6365	7,2858	71139	7,0101	5,6504	5,2168	5,0510	4,4417
Lemak	0,9892	0,9797	0,8820	0,8229	2,0272	1,6301	1,4638	1,3866	1,2775	1,2337	1,0871	0,9804
Karbohidrat	79,2693	80,9556	83,4218	85,5056	78,7108	81,5202	84,3457	85,4909	78,0866	79,5082	82,1359	85,5164

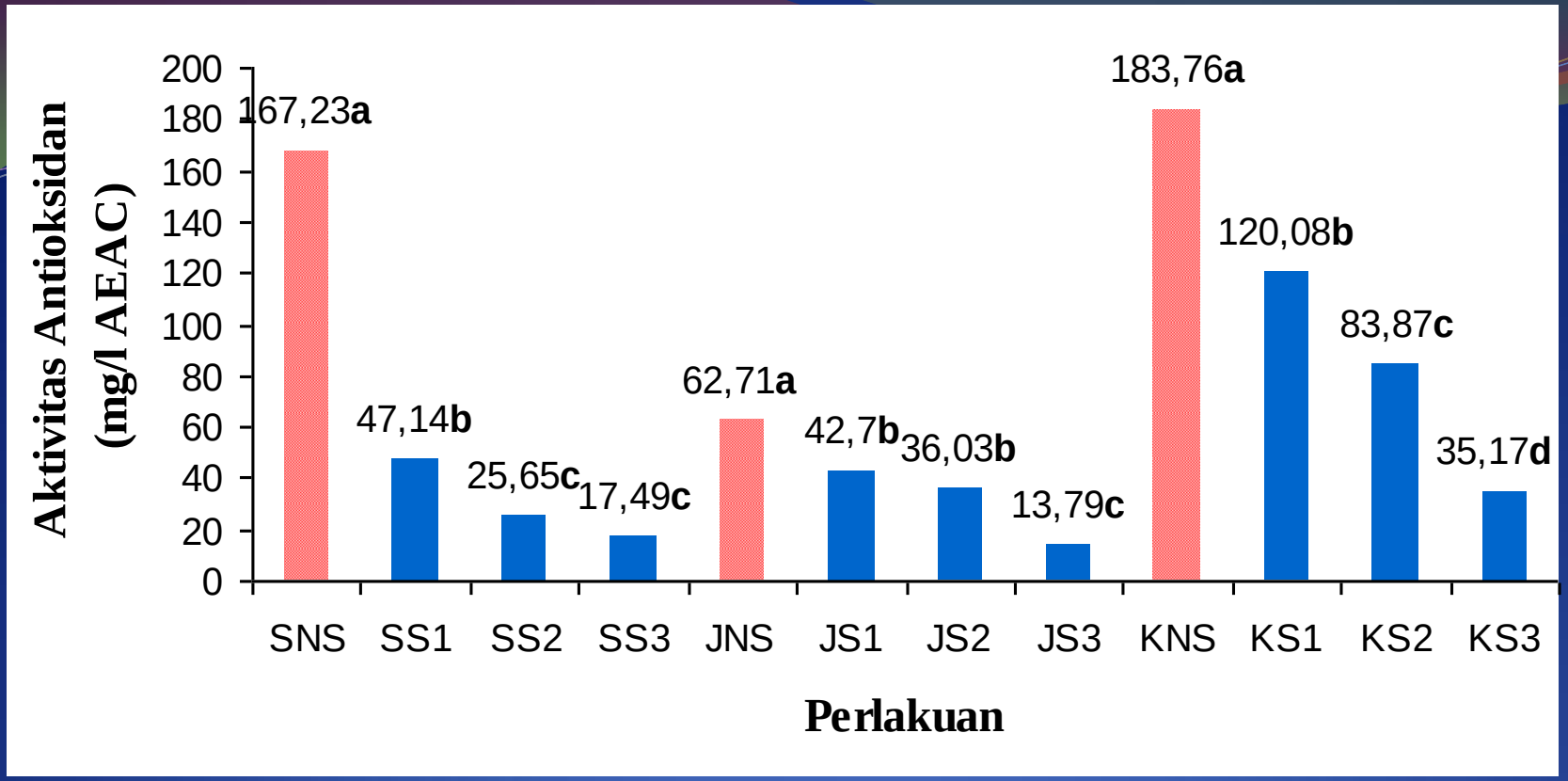


Kadar Total Fenol

Gambar 2. Rerata kadar total fenol ekstrak sorgum, jewawut dan ketan hitam akibat pengaruh perlakuan waktu penyosohan

Keterangan :
Setiap data merupakan rerata dua kali ulangan
Angka pada grafik yang mempunyai huruf beda menyatakan beda nyata (BNT α = 5%)

SNS	= Sorgum non sosoh
SS1	= Sorgum sosoh 20 detik
SS2	= Sorgum sosoh 60 detik
SS3	= Sorgum sosoh 100 detik
JNS	= Jewawut non sosoh
JS1	= Jewawut sosoh 100 detik
JS2	= Jewawut sosoh 200 detik
JS3	= Jewawut sosoh 300 detik
KNS	= Ketan hitam non sosoh
KS1	= Ketan hitam sosoh 5 detik
KS2	= Ketan hitam sosoh 15 detik
KS3	= Ketan hitam sosoh 25 detik



Aktivitas Antioksidan

Gambar 3. Rerata aktivitas antioksidan ekstrak sorgum, jewawut dan ketan hitam akibat pengaruh perlakuan waktu penyosohan

Keterangan :
Setiap data merupakan rerata dua kali ulangan
Angka pada grafik yang mempunyai huruf beda menyatakan beda nyata (BNT $\alpha = 5\%$)

SNS	= Sorgum non sosoh
SS1	= Sorgum sosoh 20 detik
SS2	= Sorgum sosoh 60 detik
SS3	= Sorgum sosoh 100 detik
JNS	= Jewawut non sosoh
JS1	= Jewawut sosoh 100 detik
JS2	= Jewawut sosoh 200 detik
JS3	= Jewawut sosoh 300 detik
KNS	= Ketan hitam non sosoh
KS1	= Ketan hitam sosoh 5 detik
KS2	= Ketan hitam sosoh 15 detik
KS3	= Ketan hitam sosoh 25 detik

Pemasakan dan Uji Organoleptik

Tabel 3. Skor Nilai Rerata Untuk Berbagai Atribut Sensori Dari Sorgum, Jewawut dan Ketan Hitam

Sorgum					Jewawut					Ketan Hitam				
Perlakuan	Atribut Sensori				Perlakuan	Atribut Sensori				Perlakuan	Atribut Sensori			
	Rasa	Warna	Aroma	Tekstur		Rasa	Warna	Aroma	Tekstur		Rasa	Warna	Aroma	Tekstur
S1	4.83^{a}	5.50^{c}	5.24^{c}	4.54^{b}	J1	**6.64^{a}**	**9.61^{a}**	6.32^{b}	6.64^{ab}	K1	**4.81^{a}**	5.53^{b}	**5.47^{b}**	**6.39^{a}**
S2	4.97^{a}	5.65^{bc}	5.30^{c}	4.69^{b}	J2	6.12^{a}	9.12^{a}	6.07^{b}	6.48^{abc}	K2	4.42^{a}	5.77^{b}	5.41^{b}	5.97^{a}
S3	**5.25^{a}**	**7.33^{a}**	5.91^{bc}	4.83^{ab}	J3	6.10^{a}	8.86^{a}	6.45^{b}	5.78^{bc}	K3	4.02^{a}	5.92^{b}	4.95^{b}	5.71^{a}
S4	4.97^{a}	5.97^{abc}	5.80^{bc}	4.73^{b}	J4	5.87^{a}	8.63^{a}	6.33^{b}	5.30^{c}	K4	4.24^{a}	**6.00^{b}**	4.95^{b}	6.20^{a}
S5	5.07^{a}	5.93^{abc}	5.50^{c}	5.59^{ab}	J5	5.73^{a}	9.57^{a}	6.51^{b}	7.10^{ab}	K5	4.41^{a}	4.85^{b}	4.36^{b}	5.40^{a}
S6	5.07^{a}	7.13^{ab}	5.74^{c}	5.41^{ab}	J6	6.46^{a}	9.19^{a}	6.30^{b}	**7.30^{a}**	K6	4.33^{a}	4.74^{b}	4.56^{b}	5.31^{a}
S7	5.22^{a}	6.86^{abc}	6.20^{bc}	5.22^{ab}	J7	6.22^{a}	9.60^{a}	6.60^{ab}	7. 24^{a}	K7	4.40^{a}	5.19^{b}	4.47^{b}	5.31^{a}
S8	5.22^{a}	6.99^{abc}	**6.21^{bc}**	**5.60^{ab}**	J8	6.34^{a}	9.45^{a}	**6.81^{ab}**	7.04^{ab}	K8	4.28^{a}	4.88^{b}	4.74^{b}	5.56^{a}
Oatmeal	5.96^{a}	7.44^{a}	7.13^{a}	6.28^{a}	*Oatmeal*	6.78^{a}	7.28^{b}	7.87^{a}	6.49^{abc}	*Oatmeal*	4.92^{a}	7.63^{a}	7.74^{a}	5.74^{a}

Keterangan :

Perlakuan untuk sorgum

- S1 = waktu sosoh 20 detik, waktu pemasakan 40 menit, perbandingan air 1:10
- S2 = waktu sosoh 20 detik, waktu pemasakan 40 menit, perbandingan air 1:11
- S3 = waktu sosoh 20 detik, waktu pemasakan 45 menit, perbandingan air 1:10
- S4 = waktu sosoh 20 detik, waktu pemasakan 45 menit, perbandingan air 1:11
- S5 = waktu sosoh 100 detik, waktu pemasakan 40 menit, perbandingan air 1:10
- S6 = waktu sosoh 100 detik, waktu pemasakan 40 menit, perbandingan air 1:11
- S7 = waktu sosoh 100 detik, waktu pemasakan 45 menit, perbandingan air 1:10
- S8 = waktu sosoh 100 detik, waktu pemasakan 45 menit, perbandingan air 1:11

Perlakuan untuk Jewawut

- J1 = waktu sosoh 100 detik, waktu pemasakan 20 menit, perbandingan air 1:7
- J2 = waktu sosoh 100 detik, waktu pemasakan 20 menit, perbandingan air 1:8
- J3 = waktu sosoh 100 detik, waktu pemasakan 25 menit, perbandingan air 1:7
- J4 = waktu sosoh 100 detik, waktu pemasakan 25 menit, perbandingan air 1:8
- J5 = waktu sosoh 300 detik, waktu pemasakan 20 menit, perbandingan air 1:7
- J6 = waktu sosoh 300 detik, waktu pemasakan 20 menit, perbandingan air 1:8
- J7 = waktu sosoh 300 detik, waktu pemasakan 25 menit, perbandingan air 1:7
- J8 = waktu sosoh 300 detik, waktu pemasakan 25 menit, perbandingan air 1:8

Perlakuan untuk ketan hitam

- K1 = waktu sosoh 5 detik, waktu pemasakan 25 menit, perbandingan air 1:7
- K2 = waktu sosoh 5 detik, waktu pemasakan 25 menit, perbandingan air 1:8
- K3 = waktu sosoh 5 detik, waktu pemasakan 30 menit, perbandingan air 1:7
- K4 = waktu sosoh 5 detik, waktu pemasakan 30 menit, perbandingan air 1:8
- K5 = waktu sosoh 15 detik, waktu pemasakan 25 menit, perbandingan air 1:7
- K6 = waktu sosoh 15 detik, waktu pemasakan 25 menit, perbandingan air 1:8
- K7 = waktu sosoh 15 detik, waktu pemasakan 30 menit, perbandingan air 1:7
- K8 = waktu sosoh 15 detik, waktu pemasakan 30 menit, perbandingan air 1:8

Kapasitas imunomodulator

Tahap pengambilan darah

Darah segar

Darah setelah di sentrifuse

Ruang kerja

Isolasi sel limfosit

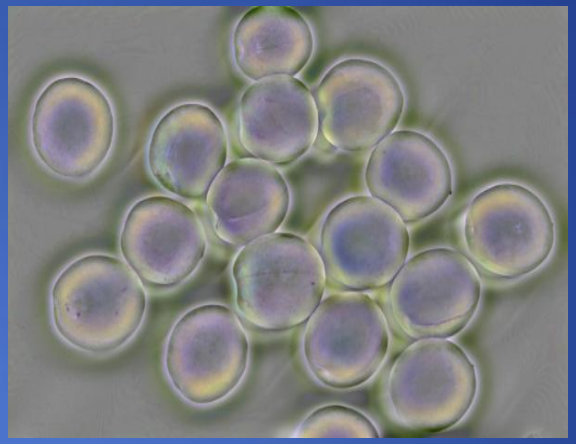
Isolasi sel limfosit

Isolasi sel limfosit

Haemacytometer

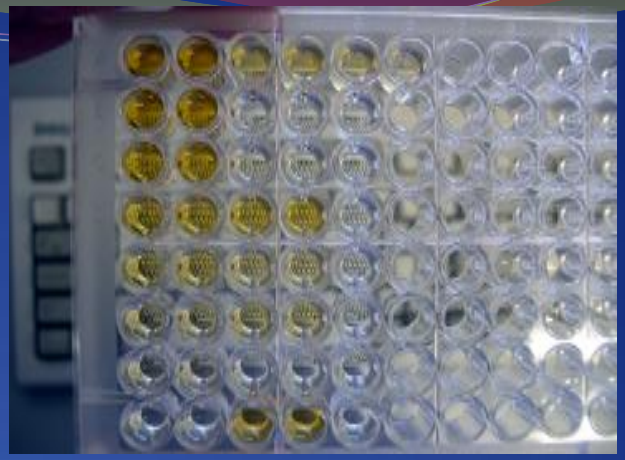
Pengamatan & penghitungan sel limfosit

Sel limfosit



Sel limfosit

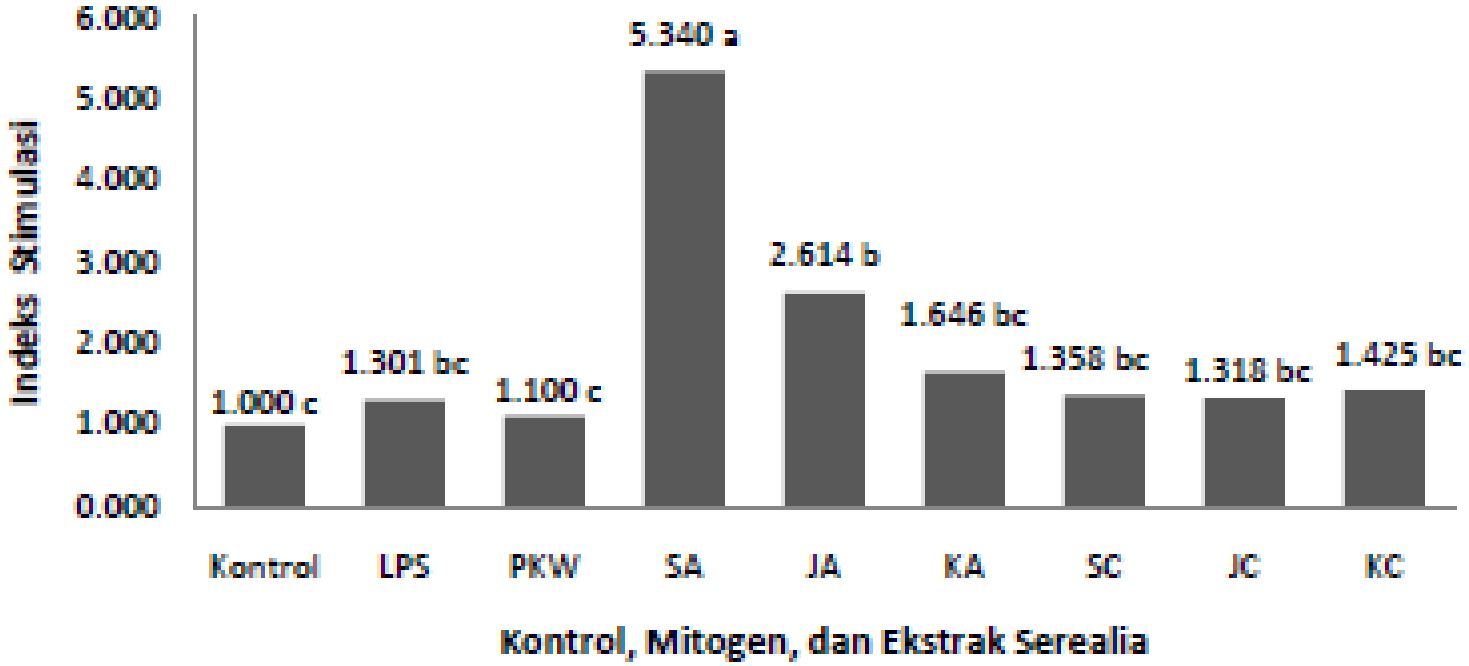
Penambahan ekstrak



Kultur pada microplate

Proses inkubasi (72 jam)

Microplate reader



Gambar 19. Nilai indeks stimulasi (IS) sel limfosit ekstrak serealia dengan kontrol dan mitogen

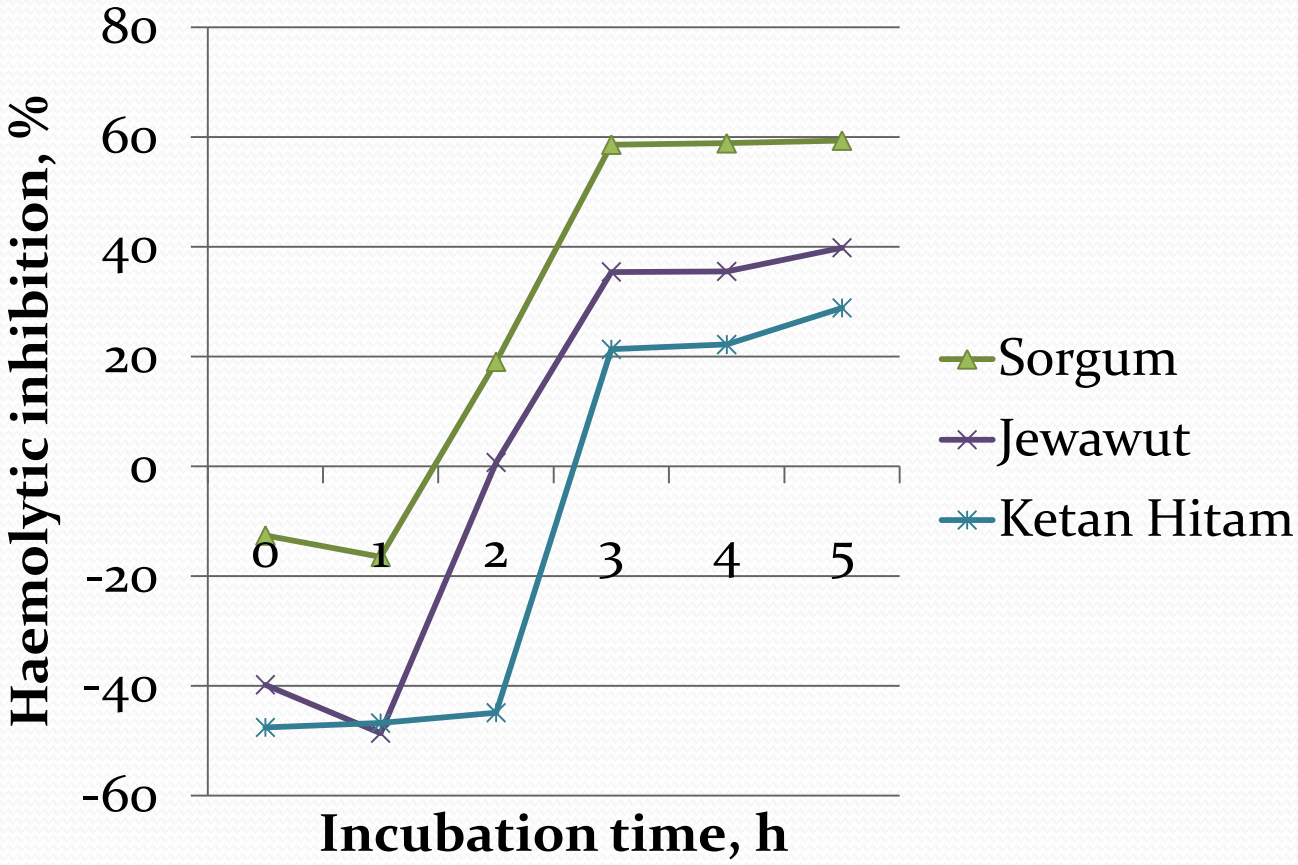
Keterangan :

Setiap data merupakan rerata dua kali ulangan

Angka pada gafik yang mempunyai huruf beda pada masing-masing serealia menyatakan beda nyata (BNT α = 5%)

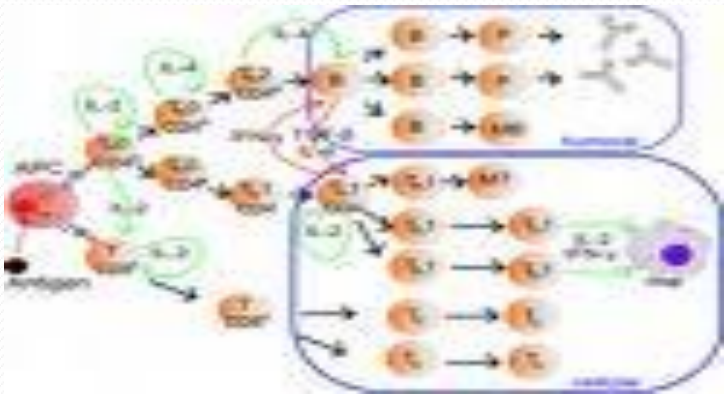
Kontrol	= Media RPMI	SA	= Ekstrak air sorgum	SC	= Ekstrak aseton sorgum
LPS	= Lipopolisakarida	JA	= Ekstrak air jewawut	JC	= Ekstrak aseton jewawut
Con A	= Concanavalin A	KA	= Ekstrak air ketan hitam	KC	= Ekstrak aseton ketan hitam

Figure 2. Hemolytic resistancy of HUMAN red blood cells exposed to H2O2 in the presence of sorghum, millet or black glutinous rice extract. Sorghum extract has the highest antioxidant activity in protecting cell lysis



OBJECTIVES

TO STUDY
THE GLYCEMIC INDEX FOR DIABETES
BODY ANTIOXIDANT ACTIVITY
ANTICANCER



METHODOLOGY

SORGHUM

RATS, 8 W, 250 G

Polished with Satake Grain tester
20 sec/ 200gr

2 WEEKS ADAPTATION

Milled with Dish Mill

7 WK FEEDING

Flour,

TERMINASI

Feed, AIN, 1976

SPLEEN,
LYMPHOCUTE
PROLIFERATION
CELLS WERE
CULTURED 3 DAYS,
LIVING CELLS: MTT

LIVER:
DPPH, MDA, SOD,
CATALASE, GPX

RAT DIET EXPERIMENTS

GROUPS	DESCRIPTION
KO	CONTROL, WITH CORN STARCH AS SOURCE OF CARBOHYDRATE
S-50	SOURCE OF CARBOHYDRATE: 50% FROM SORGHUM FLOUR, 50% FROM CORN STARCH
S-100	SOURCE OF CARBOHYDRATE: 100% FROM SORGHUM FLOUR

RESULTS & DISCUSSION

RAT GROWTH DURING 56 DAYS OF FEEDING

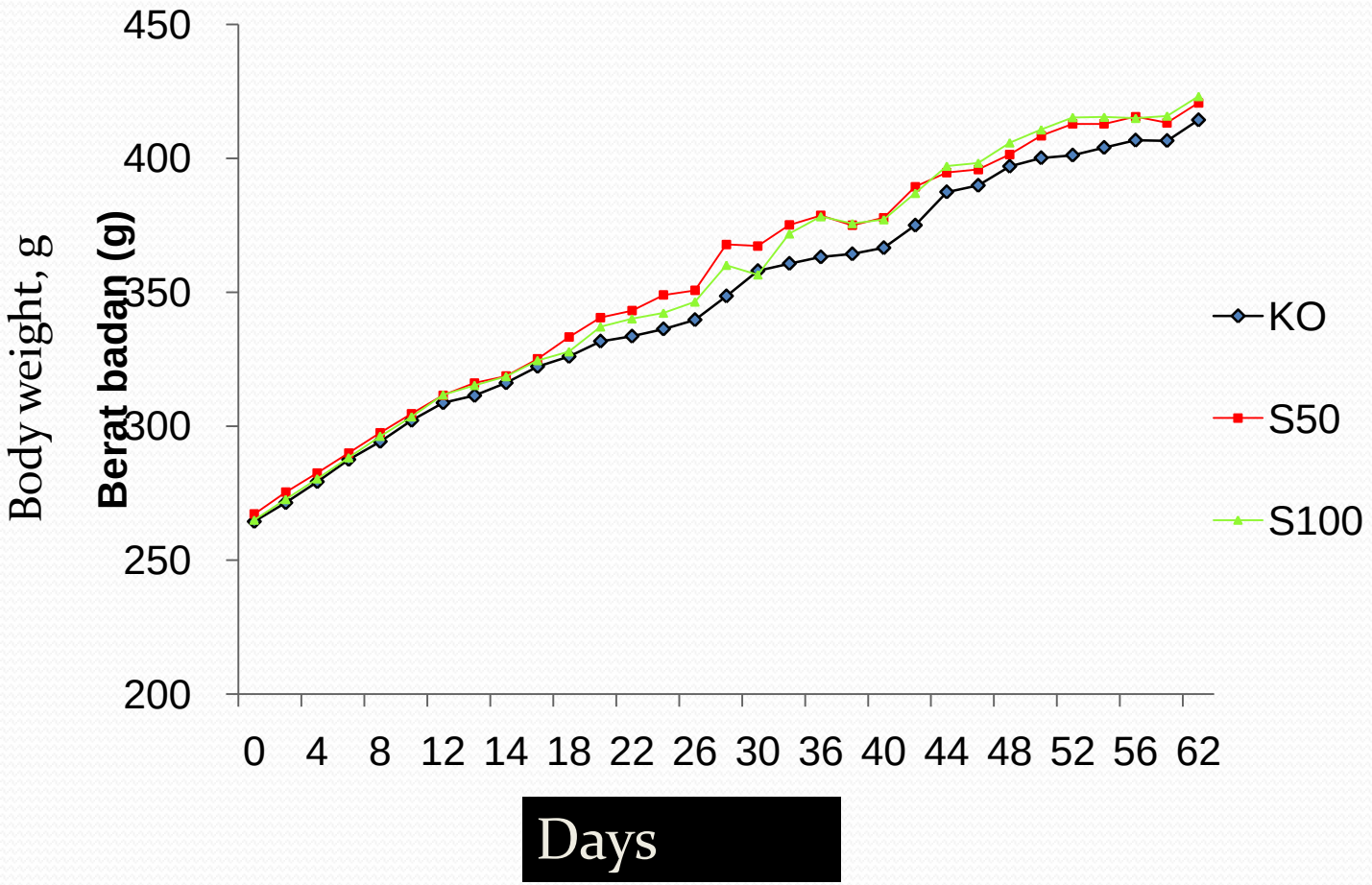


Figure 3. Growth of mice during the 29 weeks of experiment. Group A was the control group, group B, C and D received AOM carcinogen. Group C and D received sorghum 50 and 100% as the source of carbohydrate.

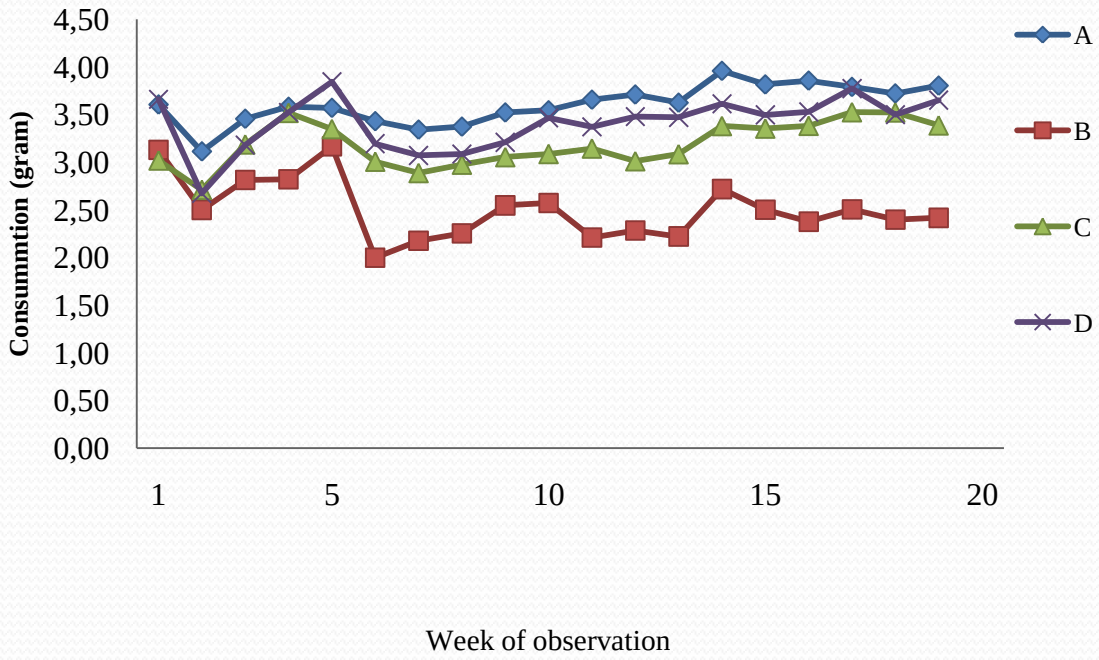
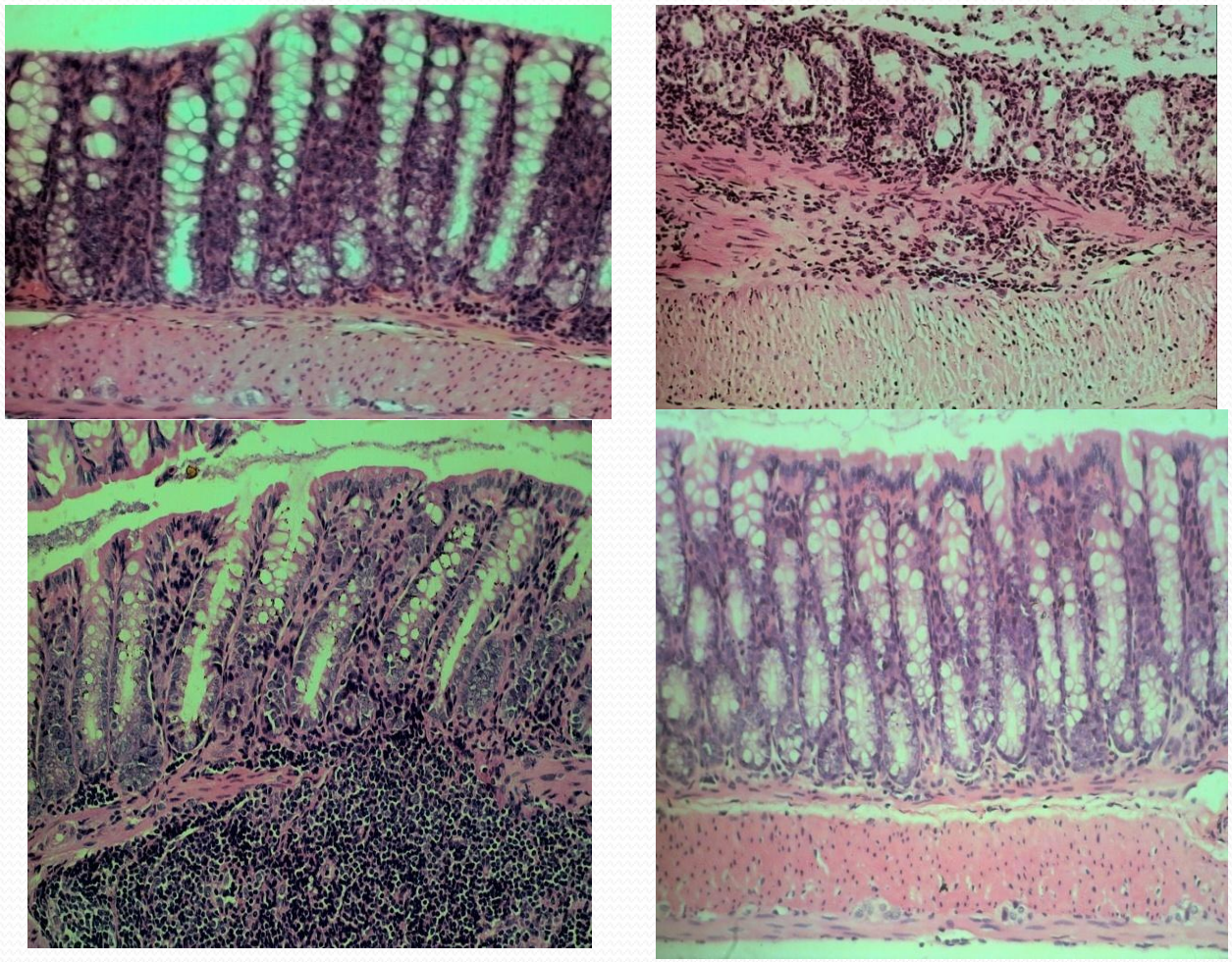


Figure 4. Photomicrograph of mice colon after consuming diets for 29 weeks and received AOM + DSS carcinogenic. Group A was the control group, group B, C and D received AOM carcinogen. Group C and D received sorghum 50 and 100% as the source of carbohydrate.



(= inflamation

, = damaged epithel,

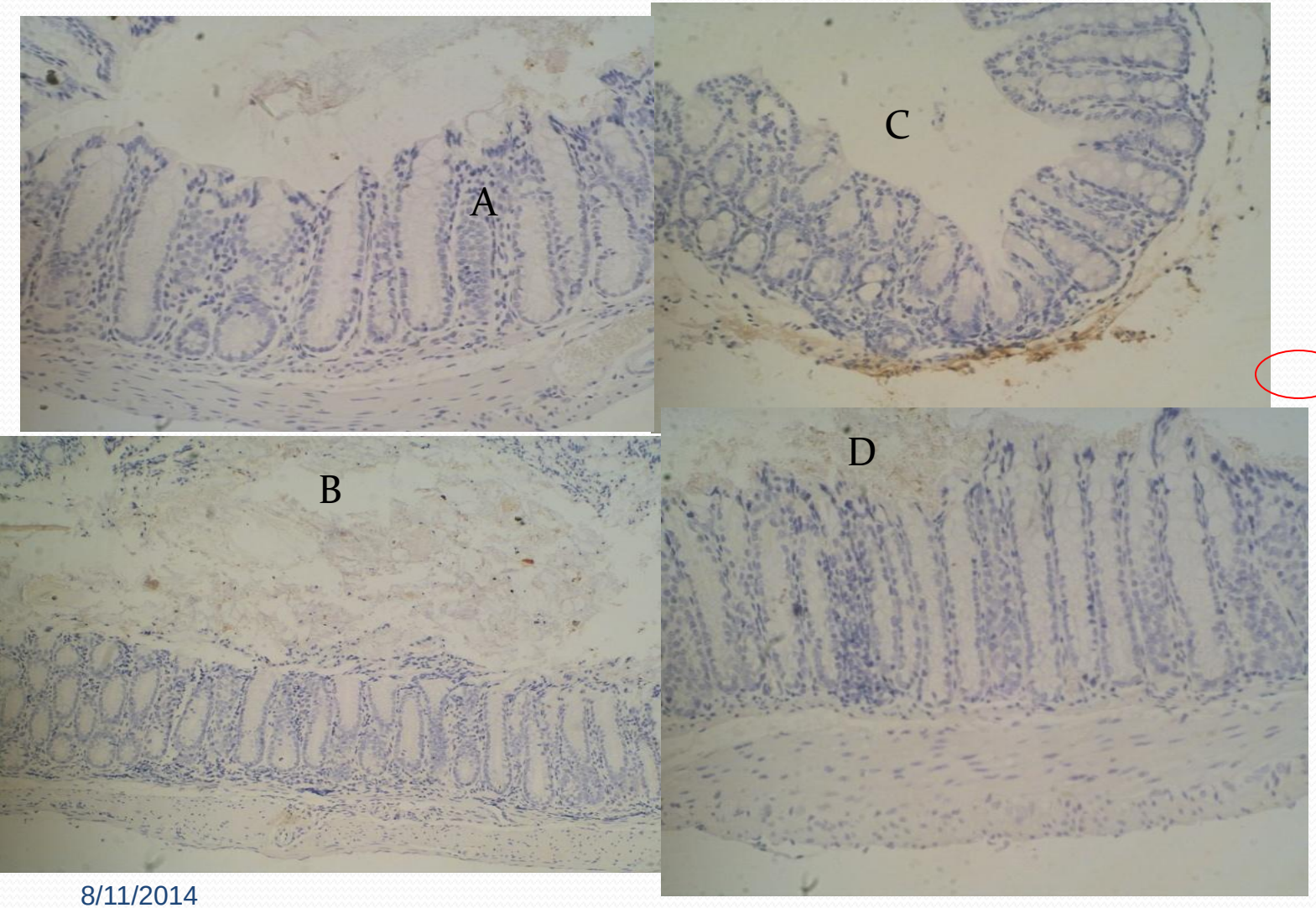
= cript aberant)

Table 2. Mice colon profile expressed by HE staining

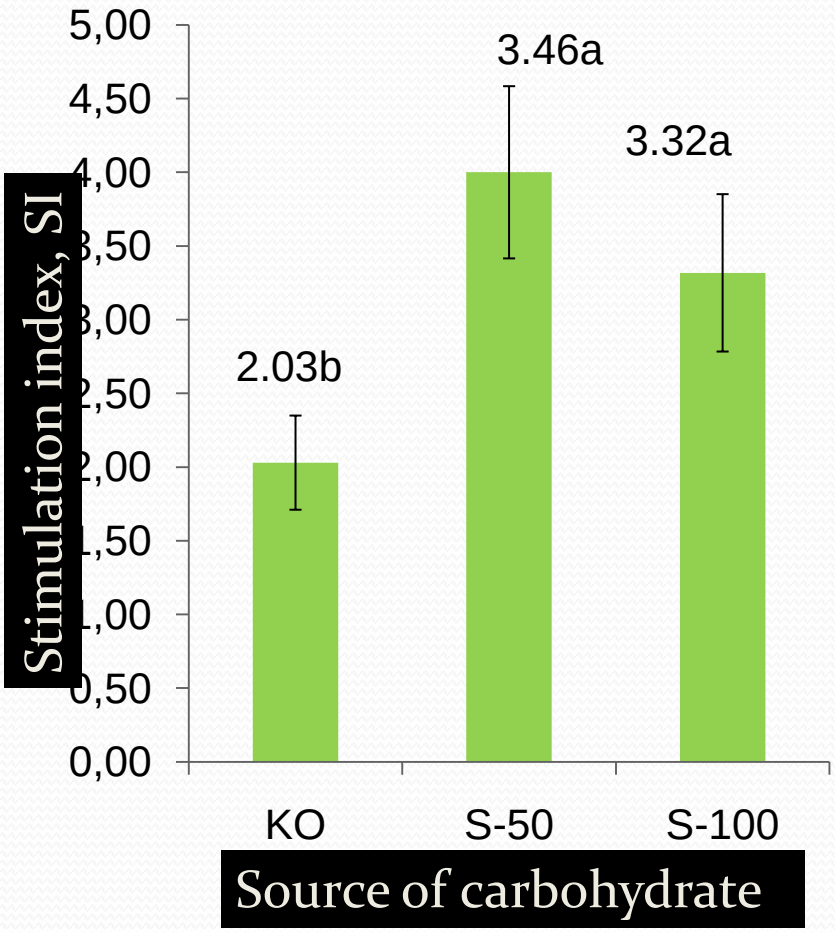
Note: Different superscripts on the same column show significant different ($p<0,05$). Group A was the control group, group B, C and D received AOM carcinogen. Group C and D received sorghum 50 and 100% as the source of carbohydrate.

Mice	Averge score of collitic mark
Group A (std + Saline injection)	$0,00^{a}\pm0,00$
Group B (std+AOM,DSS)	$3,60^{c}\pm0,50$
Group C (S50+AOM,DSS)	$1,50^{b}\pm0,54$
Group D (S100+AOM,DSS)	$1,30^{b}\pm0,51$

Figure . Photomicrograph of mice colon after consuming sorghum diets for 29 weeks and received AOM + DSS carcinogenic. Group A was the control group, group B, C and D received AOM carcinogen. Group C and D received sorghum 50 and 100% as the source of carbohydrate.



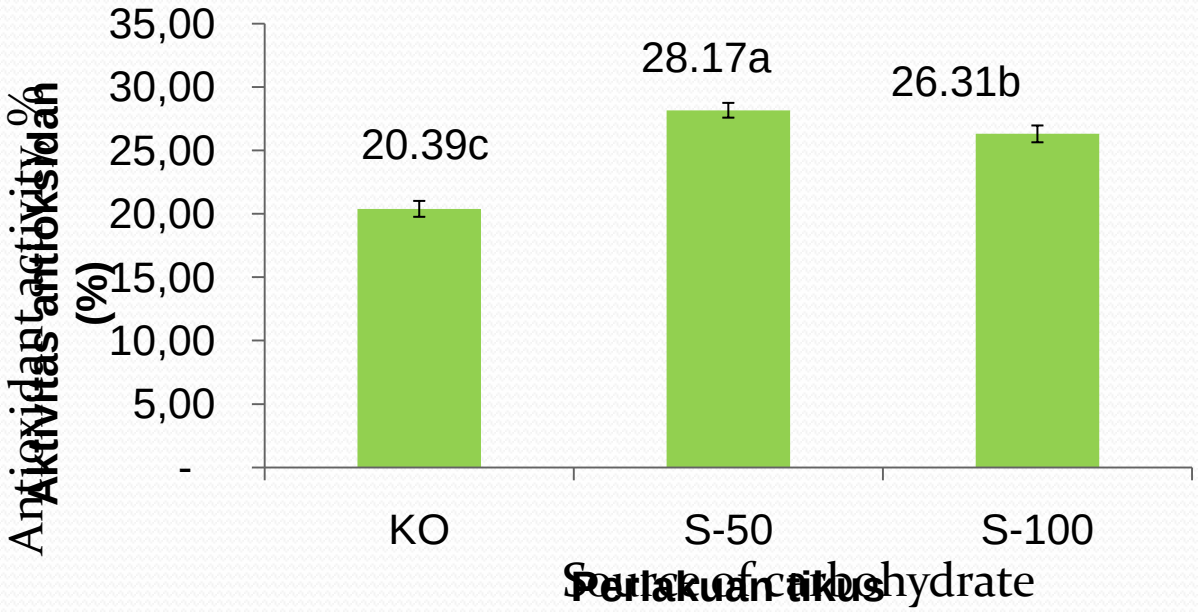
LYMPHOCYTE PROLIFERATION ACTIVITY



RATS FED SORGHUM 50 & 100% AS SOUCE OF CARBOHYDRATE HAVE LYMPHOCYTE MORE ACTIVELY PROLIFERATE (MORE LIVING CELLS) PARTICULARLY AT 50% SORGHUM

INCREMENT:
50% SORGHUM: 70%,
100 % SORGHUM: 63%,

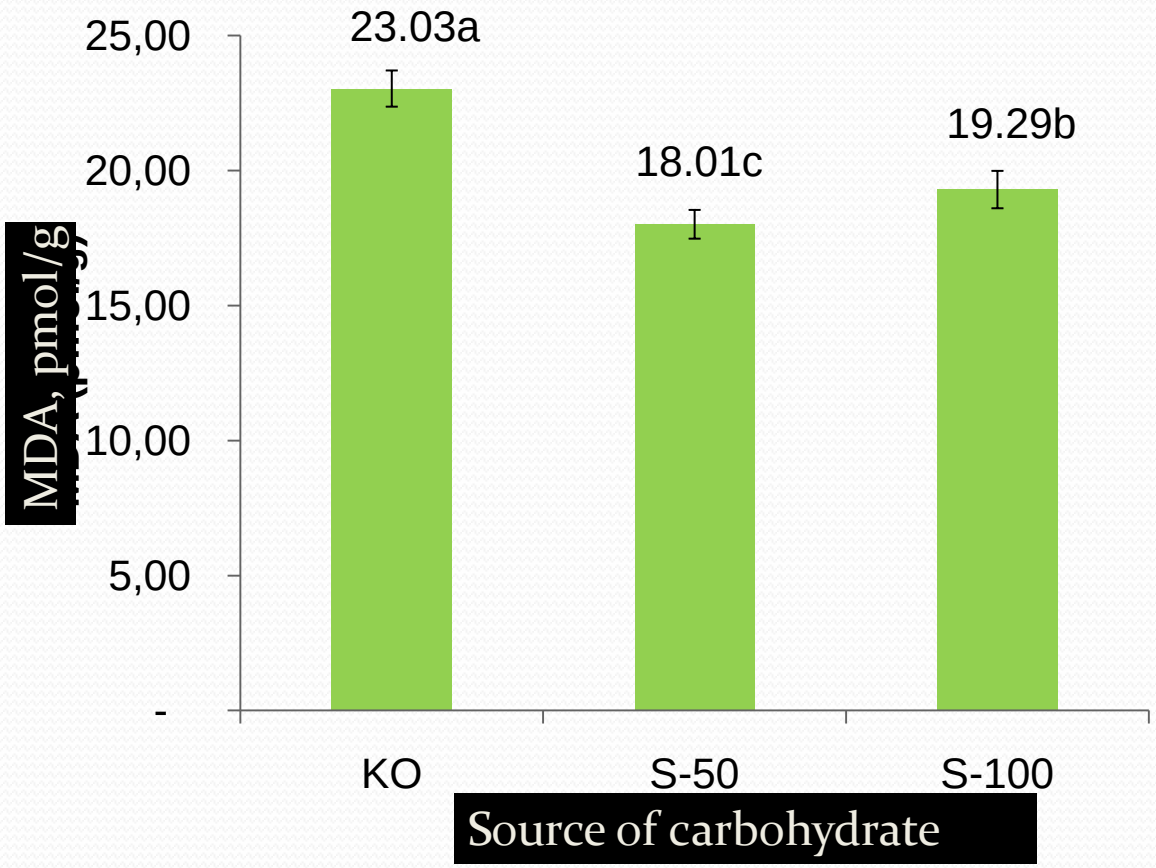
LIVER ANTIOXIDANT CAPACITY (DPPH)



KO: CONTROL; S-50: SorHgum 50%;S-100: sorgHum 100%;

FEEDING 50% AND 100% SORGHUM AS SOURCE OF CARBOHYDRATE REDUCED LIVER MDA: INDICATION OF LOWER OXIDATION PRODUCT , INCREMENT: 50% SORGHUM: 38%; 100 % SORGHUM: 28%,

LIVER MALONDIALDEHYDE (MDA)

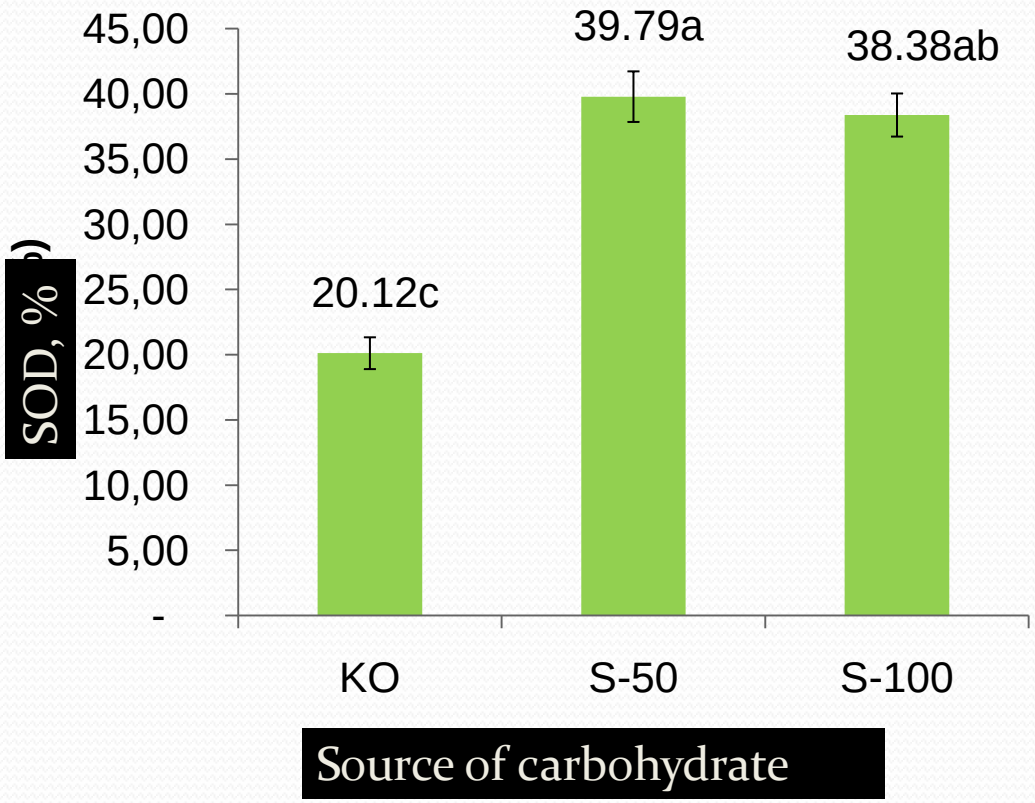


FEEDING 50% AND 100% SORGHUM AS SOURCE OF CARBOHYDRATE REDUCE LIVER MDA: INDICATION OF LOWER OXIDATION PRODUCT

INCREMENT:
50% SORGHUM: 22%;
100 % SORGHUM: 16%,
NO SIGNS OF ADVERSE EFFECT

KO: CONTROL; S-50: SorHgum 50%;S-100: sorgHum 100%;

LIVER SOD ENZYME

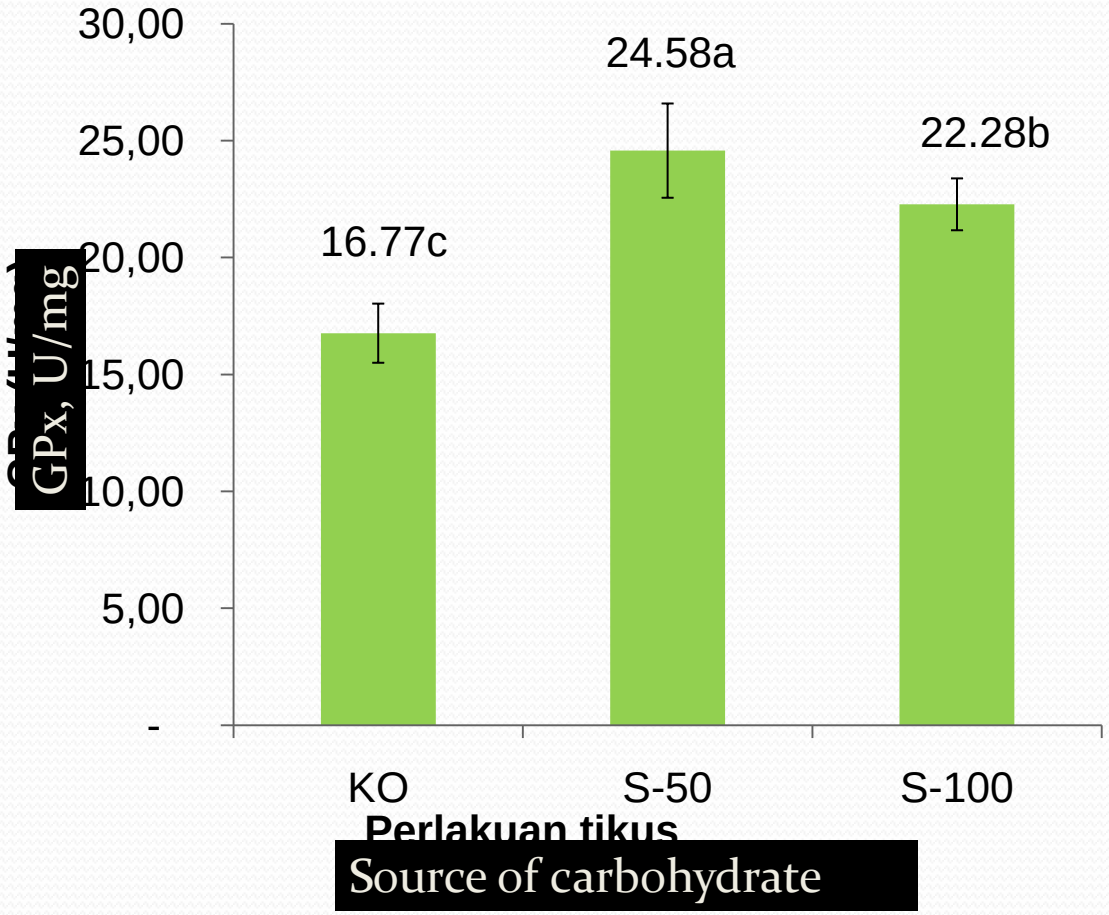


KO: CONTROL; S-50: SorHgum 50%;S-100: sorgHum 100%;

FEEDING 50% AND 100% SORGHUM AS SOURCE OF CARBOHYDRATE INCREASED LIVER SOD: INDICATION OF HIGHER ANTIOXIDANT

INCREMENT:
50% SORGHUM: 98%;
100 % SORGHUM: 91%,

LIVER ENZIM GLUTATHION PEROXYDASE (GPX)



FEEDING 50% AND 100% SORGHUM AS SOURCE OF CARBOHYDRATE INCREASED LIVER GPx: INDICATION OF HIGHER ANTIOXIDANT

INCREMENT:
50% SORGHUM: 57%;
100 % SORGHUM: 33%,

KO: CONTROL; S-50: SorHgum 50%;S-100: sorgHum 100%;

NEW PRODUCT DEVELOPMENT:

Departemen Ilmu dan Teknologi Pangan
Fakultas Teknologi Pertanian
Institut Pertanian Bogor
2010

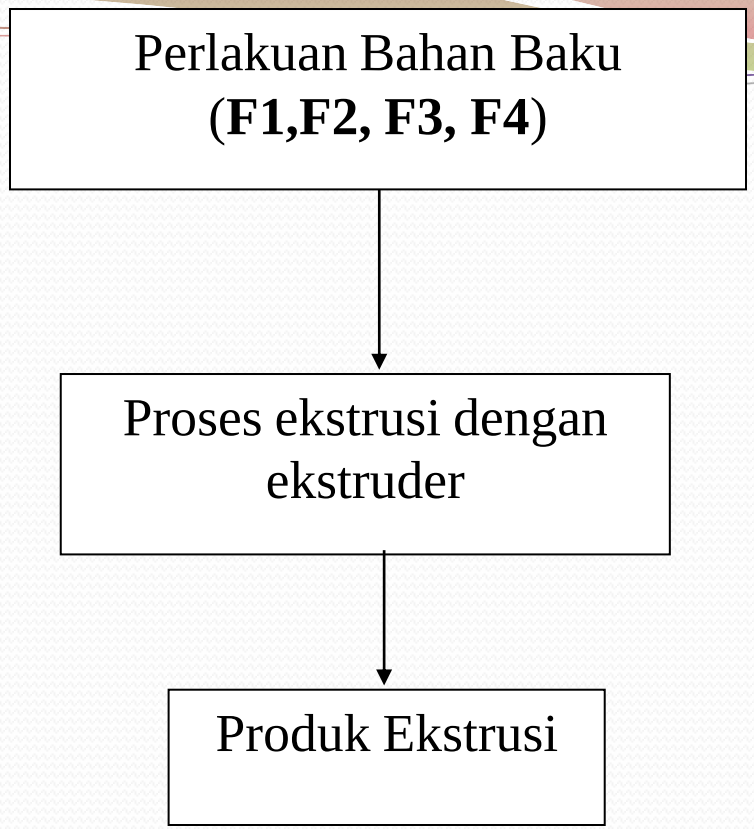


Diagram alir 2. Pembuatan produk ekstrusi berbahan dasar sorgum

Keterangan : Kadar air bahan 13-14%

Suhu ekstruder T1=1350C T2= 100 0C dan T3= 70 0C

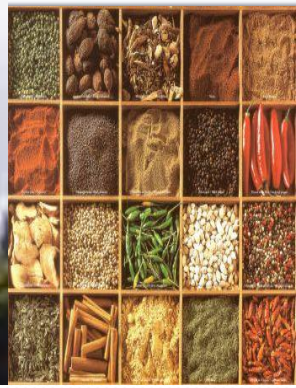
Penambahan mentega ke dalam adonan 100g dalam 3kg adonan

conclusion

Sorghum half polished has GI of 44.69 which classifies sorghum into low GI food category (DIABETES).
Sorghum has more potency in inhibiting erythrocyte lysis compare to millet and black glutinous rice extracts (ANTIOKSIDAN).
In in vivo mice study, sorghum showed inhibition on mucosal damage caused by AOM-DSS and reduce COX-2 enzyme production in mucosal cell (KANKER).

These results demonstrated anti diabetic and anticancer properties of sorghum

SPECIAL THANKS TO THE MINISTRY OF AGRICULTURE OF INDONESIA FOR RESEARCH FINANCIAL SUPPORT



THANK YOU FOR YOUR ATTENTION